

TABLE OF CONTENTS

Article title and author(s)	Original Page No.
ESTIMATING TRACTOR DEPRECIATION AND IMPLICATIONS FOR FARM MANAGEMENT ACCOUNTING by Paul Wilson and Christopher Tolley	5
IMPROVING THE DESIGN OF KNOWLEDGE TRANSFER STRATEGIES BY UNDERSTANDING FARMER ATTITUDES AND BEHAVIOUR by C. Garforth, T. Rehman, K. McKemey, R. Tranter, R. Cooke, C. Yates, J. Park and P. Dorward.	17
INTEGRATING FLOOD MANAGEMENT AND AGRIENVIRONMENT THROUGH WASHLAND CREATION IN THE UK by Morris J, Bailey A P, Alsop D, Vivash R M, Lawson C S, and Leeds-Harrison P B.	33
BUILDING A FARM BASED FOOD BUSINESS by James Parrish	49
MANAGING CHANGE THROUGH BENCHMARKING BEST PRACTICE by Trevor Atkinson	57
PERCEPTIONS AND IMPACTS OF FRAM-A: A NORWEGIAN FARM BUSINESS DEVELOPMENT PROGRAMME by O. Flaten and E. Kjesbu	75
THE LUXEMBOURG COMMON AGRICULTURAL POLICY REFORM AGREEMENT: IRISH DAIRY FARMERS DEVELOPMENT OPTIONS by L. Shalloo, P. Dillon, M. Rath, and M. Wallace	91
E-BUSINESS DEVELOPMENTS IN THE IRISH AGRIBUSINESS INDUSTRY by P. Brandon, Dr. J. O'Connell, Dr. D.J. Ruane, Dr. P. Wims	105
RETURNS TO FARMLAND AND FARM LABOUR AND MANAGEMENT IN WESTERN CANADA by Marvin J. Painter	123
BENCHMARKING FARM ENTERPRISES by Franks, J, R and Haverty, M. J. P.	143
MANAGEMENT EXPERIENCES OF A PART TIME FARMER by Graham Dalton	187
EXTERNAL EFFECTS OF MITIGATING MEASURES TO REDUCE LARGE CARNIVORE PREDATION ON SHEEP by Leif Jarle Asheim and Ivar Mysterud	206
WORLDWIDE AGRICULTURE - THE ISSUES by Suzanne Blumhardt	214
MID TERM REVIEW– THE FRENCH REACTION by Michel Pivard	223
‘TO PRODUCE OR NOT TO PRODUCE?’ - IS THAT THE QUESTION? by James Jones	235
QUANTIFYING POTENTIAL SEXED SEMEN USE WITHIN UK SUCKLER BEEF ENTERPRISES by Telford, D. J, Franks, J. R. and Beard, A.P.	251
FARMERS, TRAINING AND BUSINESS PERFORMANCE: DOES IT STACK UP? by S. M. Byles	267
HARNESSING THE SOCIAL AND NATURAL SCIENCES FOR SUSTAINABLE RURAL DEVELOPMENT: INTRODUCING THE RURAL ECONOMY AND LAND USE PROGRAMME by Jeremy Phillipson, Jo Daymond, Philip Lowe and Richard Lee	277

A LAND MANAGER'S PERSPECTIVE by Mark Tinsley	287
THE ECONOMIC IMPLICATIONS OF COMPLYING WITH A LIMIT ON ORGANIC NITROGEN IN A DECOUPLED POLICY ENVIRONMENT – AN IRISH CASE STUDY by T. Hennessy, L. Shalloo and P. Dillon	297
EXAMINING THE COMPETITIVENESS OF CEREAL PRODUCTION IN SELECTED EU COUNTRIES by F.S. Thorne	313
FARM OWNERSHIP AND MANAGEMENT IN RUSSIA: A STUDY OF THE NOVOSIBIRSK REGION by J.R. Franks, Zemfira I. Kalugina, Olga Fadeeva and Irina Davydova.	329
RECONNECTING CONSUMERS WITH AGRICULTURE by Dame Deirdre Hutton	351
THE THIRD FARM MANAGEMENT LECTURERS CONFERENCE: HARPER ADAMS UNIVERSITY COLLEGE 11-12 APRIL 2005 by Graham Tate, Julian Park and Ian Edwards	360
SUCKLER BEEF PRODUCERS USING MATHEMATICAL PROGRAMMING by Crosson P., O'Kiely P., O'Mara F.P. and Wallace M.	369
COMPARISON OF RISK IN ORGANIC, INTEGRATED AND CONVENTIONAL CROPPING SYSTEMS IN EASTERN NORWAY by Gudbrand Lien, Ola Flaten, Audun Korsæth, Keith D. Schumann, James W. Richardson, Ragnar Eltun and J. Brian Hardaker	385
COLLABORATIVE SUPPLY CHAIN INVESTMENT: AN IMPERATIVE FOR BRITISH FARMING? by Siôn Roberts	402
REVIEW OF THE 15TH IFMA CONGRESS, BRAZIL by Matthew Naylor	416
COUNTING THE COST OF IMPROVED WELFARE FOR BREEDING SOWS IN THE UK by Cain, P. J. and Guy, J. H.	427
PROFILES OF SHEEP AND GOAT FARMERS' MARKETING STRATEGY IN THE REGION OF EAST MACEDONIA AND THRACE IN GREECE by L. Tsourgiannis, J. Eddison, M. F. Warren and A. Errington	443
COST EFFICIENCY IMPROVEMENT IN MILK PRODUCTION, ENGLAND AND WALES 1997-2003 by David Colman and Yaqin Zhuang	531
FARMERS' PERCEPTIONS OF THE SINGLE PAYMENT SCHEME CROSS COMPLIANCE MEASURES by James Jones	540
MAXIMISING FARM BUSINESS PROFITABILITY IN THE NEW ENERGY ERA by Ralph Blaney	557
CHINA: THREAT OR OPPORTUNITY by John Chapple	567
WIDENING HORIZONS FOR DAIRY FARMERS: LINCOLNSHIRE POACHER CHEESE by Simon Jones and Tim Jones	575
IS THE GOVERNMENT USING THE BRITISH FARMER AS A SACRIFICIAL LAMB? by Tim Bennett	580
FARM RISK MANAGEMENT: PAST, PRESENT AND PROSPECTS by J Brian Hardaker	593

HELPING FARMERS ADJUST TO POLICY REFORMS THROUGH DEMONSTRATION FARMS: LESSONS FROM A PROJECT IN ENGLAND by A P Bailey, C J Garforth, B Angell, T. Scott, J Beedell, S Beechener and R B Rana	613
FARMING FUTURES: SOME IMPACTS OF THE FISCHLER REFORMS ON LIVESTOCK FARMING IN THE NORTH EAST OF ENGLAND by Jeremy Franks	627
FROM MAFF TO DEFRA– A POLICY CHANGING JOURNEY FOR AGRICULTURE by Neil Carmichael	643
WHAT KIND OF AGRICULTURAL POLICY DO WE NEED IN A TWENTY FIRST CENTURY EUROPE? by Carl Atkin	649
GROSS MARGIN ACCOUNTING AS A SOCIAL PRACTICE by Lisa Jack and Martin Collison	665
EVALUATING PRODUCERS' PERSPECTIVES ON SELLING RAW WOOL: A FIELD STUDY OF BEHAVIOURAL FACTORS AND VARIABLES by Elizabeth Jackson, Mohammed Quaddus, Nazrul Islam, John Stanton	679
ESTIMATING THE UNIT COSTS OF PRODUCING OILSEED RAPE IN ENGLAND by L.J. Hubbard, P.J. Dawson and C.R. Scott	709
REVIEW OF PAPERS PRESENTED AT A SEMINAR ON FARM RISK MANAGEMENT ORGANISED BY THE NORDIC ASSOCIATION OF AGRICULTURAL SCIENTISTS, IN OSLO, NORWAY ON 14-16 JUNE 2006 by Agnar Hegrenes, Norwegian Agricultural Economics Research Institute	719
E-BUSINESS READINESS OF WINE PRODUCERS IN ROMAGNA (ITALY): THE IMPORTANCE OF AREA OF ORIGIN EFFECTS by Maurizio Canavari, Alessandro Farneti , Marco Lucchi , Martyn Warren.	731
RESPONDING TO THE CHALLENGES OF POLICY DECOUPLING AND MARKET LIBERALISATION: THE CASE OF THE UK SUGAR INDUSTRY by Carl Atkin	749
THE CHALLENGE OF BIOFUELS by M. C. Bennett	769
CLIMATE CHANGE AND UK AGRICULTURE by Sir John Houghton	783
IF YOU NEVER TAKE A RISK YOU WILL NEVER REAP A REWARD by Doug Wanstall	797

REFEREED PAPER

**ESTIMATING TRACTOR DEPRECIATION AND
IMPLICATIONS FOR FARM MANAGEMENT
ACCOUNTING***Paul Wilson and Christopher Tolley*

Using data on 968 observations of used tractor prices the results of a depreciation model are compared with standard depreciation rates often used in Farm Management accounting. The model results show that depreciation increases with age, hours worked and horse-power and significant differences exist between percentage depreciation across some manufacturers. The model explains 84.2% of the variation in depreciation and provides a significantly better representation of tractor depreciation than standard methods of calculating depreciation that ignore the effect of hours worked, horse-power and manufacturer. Future research should concentrate on obtaining accurate information on manufacturer discounts and accounting for the influence of care, condition and additional features of each tractor.

Keywords. Tractors, Depreciation, Management Accounting

1. Introduction

Machinery and power costs in agriculture account for a substantial proportion of all costs. For example, on UK mainly cereal farms of 150-300 hectares, machinery and power accounts for 33% of all costs (Anon, 2003). The importance of machinery costs in agriculture, and particularly tractor costs, has motivated studies examining depreciation accounting techniques (e.g. Yule, 1995) and tractor price-quality indices (Rayner, 1968; Cooper *et al.*, 1993). Tractor depreciation has been estimated in the US by Reid and Bradford (1983), Perry *et al.* (1990), Cross and Perry (1995), Unterschultz and Mumey (1996) and Dumler *et al.* (2000), and in the UK by Williams (1980), Cunningham and Turner (1988) and Wilson and Davis (1998). Thus there has been much interest in factors affecting tractor prices, depreciation and costs. The above depreciation studies generally agree that the main factors affecting depreciation include the tractor's age, usage, power and manufacturer. Data availability have led different authors to also consider the effect of care and condition, added extras, regional influences (e.g. Cross and Perry, 1995) and tractor type (tracked or wheeled) (e.g. Hansen and Lee, 1991).

The general methodological approach taken in depreciation studies is to regress percentage depreciation (or remaining value) upon a series of explanatory variables (e.g. age, usage, power) that affect depreciation. Within this approach the two main issues that arise are; the availability, assumptions and manipulation of data to produce the required data set and the type of regression and functional form chosen to represent the relationship between depreciation and independent variables. With respect to data availability some authors have utilised farm dispersal sale data (Perry *et al.*, 1990; Cross and Perry, 1995) whereby a direct price for a used tractor is obtained, whilst others have used secondary sources taken from dealer advertisements in trade magazines (Wilson and Davis, 1998). Studies that utilise data from trade advertisements are based upon the advertised sale price from dealers.

However, the price that a vendor receives when selling, or trading-in, a tractor (the trade-in price) will generally be lower than the advertised selling price. As such, studies that use advertised dealer prices must make an assumption about the difference between advertised prices and the trade-in price received by the vendor. This is needed to calculate the value received for the used tractor net of dealer margins. Moreover, in the UK at least, new prices of tractors are typically not directly observable due to the manner in which tractors are marketed (Cooper *et al.*, 1993). New "list-prices" are available, but considerable discounts¹ are offered on these list prices, and thus a manner of determining the difference between list- and actual- new prices must be either assumed (Wilson and Davis, 1998) or calculated. The difficulties with calculating this discount lies in the commercially sensitive nature of the discounts offered and the requirement to determine the discount both over time (historically) and across manufacturers.

The two main methods used to estimate depreciation in previous work have been ordinary least squares (OLS) regressions and Box-Cox transformations. Whilst there is general agreement that, for example, depreciation and age are not directly linearly related, some previous work has transformed the data prior to estimation. One approach is take the natural logarithm of age and use this transformed variable to help overcome the non-linearity between depreciation and age but still allow the use of OLS (Wilson and Davis, 1998). Others have used the non-linear Box-Cox transformation arguing that the flexibility of Box-Cox allows the data to determine the functional form rather than imposing the form at the outset (Perry *et al.*, 1990; Cross and Perry, 1995; Unterschultz and Mumey, 1996). Dumler *et al.* (2000) used pairwise comparisons of the mean absolute percentage error (MAPE) and forecast accuracy regression models to assess which model was the most accurate, finding that the Box-Cox model employed by Cross and Perry (1995) was the most accurate of the six models considered². However, it is difficult to directly draw conclusions about the merits of the different models given that the studies used to generate the parameter estimates utilised by Dumler *et al.* (2000) were themselves derived from different data sets relating to different market conditions. Moreover, the models considered by Dumler *et al.* did not include any model estimated via OLS and thus does not provide a direct examination of OLS versus non-linearly estimated depreciation models. In addition a number of standard depreciation parameters or fixed depreciation rates are often used in farm management accounting and there is little research that examines how appropriately these standard rates accord with empirical evidence.

The aims of this paper are to address the main points raised above. First, to provide a detailed methodology of deriving and producing data sets which give a realistic representation of the market price for new and used agricultural tractors. Second, to briefly explore the differences that estimating linear and non-linear models infer for predicting depreciation in tractors and provide

1. Typically such discounts can be up to 40% of the list price.

2. The models examined by Dumler *et al.* (2000) include regression models, fixed parameter geometric models, US tax income methods and official US guides covering values of tractors and farm equipment. See Dumler *et al.* (2000) for details.

results of a preferred methodology for examining depreciation. Third, to examine how closely results of this empirical study match standard depreciation rates. The remainder of the paper is structured as follows. The next section presents the data used; section 3 presents the methodological approach taken and presents the results of the preferred model. Section 4 compares the results of the preferred model with standard methods of calculating depreciation and provides tables of estimated trade-in values. The final section provides summary comments and details some avenues for future research.

2. Data

Data on used tractors were obtained from the trade magazine advertisements in Farmers Weekly, Farm Ad and Wrights Farming Register from January to October of 2001. Information recorded for each tractor were the advertised price, age, number of hours worked, make and model. An age boundary was imposed and only those tractors with a first registration of 1986 or later were included. Data were only taken from dealer or trade advertisements and thus private sales were excluded. This was undertaken as private sales will not offer warranty packages or after sales care as will be the case for dealers. A total of 968 observations were recorded. In order to obtain a price for each tractor net of the used-tractor-dealer-mark-up, it was assumed that the difference between advertised price and trade-in value was a margin of £500 plus 10% of the advertised price. This assumption was made to account for a dealer margin recognising that the advertised sale price forms the starting price for negotiation between dealer and *purchaser* of the second-hand tractor, and is therefore often unlikely to be the final selling price of the second-hand tractor. Therefore the above margin was calculated and subtracted from the advertised dealer price to produce a net-of-dealer-mark-up-price received by the vendor when selling the second-hand tractor to the dealer. To accompany the used data set, list prices for each tractor when new were obtained from Power Farming and Farmers Weekly. Following Wilson and Davies (1998) this list price was then adjusted for inflation using the price index for agricultural tractors (Central Statistical Office, *various*) to produce a real-terms list price for each tractor. From the published list prices the power rating of the tractor (in terms of engine horse-power) were also collected. As noted above considerable discounts exist from the list price. Previous research used a standard discount rate of 22.8% of the list price in the UK, but noted that this was an area where further research was required in order to more accurately reflect the variation in discounts offered by different manufacturers (Wilson and Davis, 1998). To address this problem, dealers were approached for each of the five main tractor manufacturers (which account for 90% of the observations) and asked to provide a quote for a net of discount price for a mid-range tractor. This was then calculated as a percentage of the list price to determine the discount offered from the list price. However, this discount is only applicable for the year of interest and it was not possible to obtain historic discount rates. To overcome this issue an average discount rate for all makes over the period 1986-2001 was calculated from the net of discount prices quoted in Nix (*various*) and the average list prices for a range of tractors from original list price data from Power Farming and Farmers Weekly.

Manufacturer specific discounts for the period 1986-2001 were then calculated via a manufacturer correction factor. Manufacturer correction factors were calculated by taking the difference between the manufacturer discounts in 2001 and the average discount calculated from Nix (2000) for 2001. This correction factor was then applied to the average discount calculated from Nix for each year to produce year specific manufacturer discounts. These manufacturer specific discounts are given in Table 1 for 1986-2001. Discounts are provided for the main five manufacturers; it was assumed that other manufacturers offered the average discount.

Table 1. Calculated Percentage Discount Rate by Manufacturer 1986-2001

Year	Discount rate calculated from Nix	Adjusted discount rate	Case	Ford/NH	MF	JD	JCB	Other
2001	19.44	28.83	37.12	18.95	29.11	27.50	31.49	28.83
2000	19.47	28.86	37.15	18.98	29.14	27.53	31.52	28.87
1999	13.72	23.11	31.40	13.23	23.39	21.78	25.77	23.11
1998	19.89	29.28	37.57	19.40	29.56	27.95	31.94	29.29
1997	23.35	32.74	41.02	22.85	33.01	31.40	35.39	32.74
1996	22.98	32.37	40.66	22.49	32.65	31.04	35.03	32.38
1995	23.53	32.92	41.21	23.04	33.20	31.59	35.58	32.92
1994	24.14	33.53	41.81	23.64	33.80	32.19	36.18	33.53
1993	19.95	29.34	37.63	19.46	29.62	28.01	32.00	29.34
1992	15.34	24.73	33.02	14.85	25.01	23.40	27.39	24.73
1991	15.54	24.93	33.22	15.05	25.21	23.60	27.59	24.93
1990	16.16	25.55	33.84	15.67	25.83	24.22	28.21	25.55
1989	20.24	29.63	37.92	19.75	29.91	28.30	32.29	29.63
1988	18.08	27.47	35.76	17.59	27.75	26.14	30.13	27.47
1987	14.17	23.56	31.85	13.68	23.84	22.23	26.22	23.56
1986	10.84	20.23	28.51	10.34	20.50	18.89	22.88	20.23

The percentage depreciation for each tractor was then calculated by the difference in the new price net of discount and adjusted for inflation (new real price) and the used price net of the dealer mark up divided by the new real price and expressed as a percentage. Dummy variables were constructed for five of the manufacturers³. Table 2 provides summary statistics for the data set, indicating the large range of variation around the means for each of the variables listed.⁴

3. Case (158 observations) was set as the base and dummy variables were constructed for Ford/New Holland (263), Massey-Ferguson (160), John Deere (238), JCB (53) and "other" (96). It is necessary to have $k-1$ dummy variables (where k = number of categories of the qualitative variable (e.g. make)) to avoid perfect collinearity in the estimation of the regression equation.

4. The year of life is included in preference to the age of a tractor, as a tractor enters its first year of life as soon as it is purchased from new, whereas it does not become aged one until after its first year of life.

Table 2. Summary Statistics of Continuous Data.

	New Price (net of discount) £	Used Price (net of dealer markup) £	Percentage depreciation	Year of life	Hours worked	Horse Power rating (HP)
Mean	32 209	13 944	56.74	6.89	3 773	120.94
SD	9 739	7 028	16.85	3.58	2 213	37.34
Min.	7 053	2 200	5.72	1.00	80	20.00
Max.	68 823	40 000	87.98	16.00	12 000	306.00

3. Methodology and Results

The methodological approach taken was in-part designed to examine the trade-off between using OLS and Box-Cox. The rationale behind this approach lies in the ease of interpretation that OLS estimates provide versus the flexibility and thus potential for a better explanation of the variation within the data that the Box-Cox models may provide. Consequently, a number of OLS and Box-Cox specification models were estimated. After comparison of results the preferred model was chosen on the basis of three factors. First, the correlation coefficient between actual and predicted levels of depreciation. Second, comparing statistical differences between models based on the respective mean absolute percentage error (MAPE) as suggested by Dumler *et al.* (2000) and Gençay and Yang (1996). For the models examined above the MAPEs were calculated based on the absolute difference between observed and predicted percentage depreciation.⁵ Third, ease of interpretation of results of the parameter estimates, with the OLS specification providing more readily interpretable results.

The preferred model (equation 1) builds on the equation used in Wilson and Davis (1998). The model, estimated via OLS, includes two notable features in comparison to Wilson and Davies (1998). Specifically, the age of the tractor is captured by the natural logarithm of the year of life and also a variable (Y1) is included to account for the observed high level of depreciation that occurs in the first year of a tractor's life.

$$\text{Dep} = \alpha_0 + \alpha_1 Y1 + \beta_1 \ln yr + \beta_2 HP + \beta_3 HRS + \delta_1 JD + \delta_2 MF + \delta_3 NH + \delta_4 JCB + \delta_5 O + e \quad (1)$$

Where:

$\alpha_0, \alpha_1, \beta_k$ and δ_j ($k=1, \dots, 3, j=1, \dots, 5$) are coefficients to be estimated.

Dep the percentage depreciation

Y1 1 if tractor is in the first year of life, 0 otherwise

Ln yr natural logarithm of the year of life of tractor

HP the manufacturers rated horsepower of tractor

HRS the number of hours the tractor has worked

JD 1 if the tractor is a John Deere (JD), 0 otherwise

MF 1 if the tractor is a Massey-Ferguson (MF), 0 otherwise

NH 1 if the tractor is a Ford/New Holland (NH), 0 otherwise

JCB 1 if the tractor is a JCB, 0 otherwise

O 0 if the tractor is a Case, JD, MF, NH or JCB, 1 otherwise

e disturbance term with usual properties

5. The absolute percentage error (APE) is calculated here by $\text{APE} = |(O-P)/O| * 100$ where O is the observed percentage depreciation and P is the predicted percentage depreciation. Full details of results of the models are available from the corresponding author upon request.

The results of the above model are given below in Table 3

Table 3. Parameter Estimates of Depreciation Model.

Parameter	Estimate	t statistic
Intercept	2.146	1.54
<i>Y1</i>	12.372	6.90 *
<i>Lnyr</i>	19.943	10.10 *
<i>HP</i>	0.068	10.83 *
<i>HRS</i>	0.00210	14.38 *
<i>JD</i>	-0.562	-0.78
<i>MF</i>	6.188	7.95 *
<i>NH</i>	6.648	9.52 *
<i>JCB</i>	-1.798	-1.67
<i>O</i>	2.541	2.88 *
<i>R</i> ²	0.842	
γ	0.918	

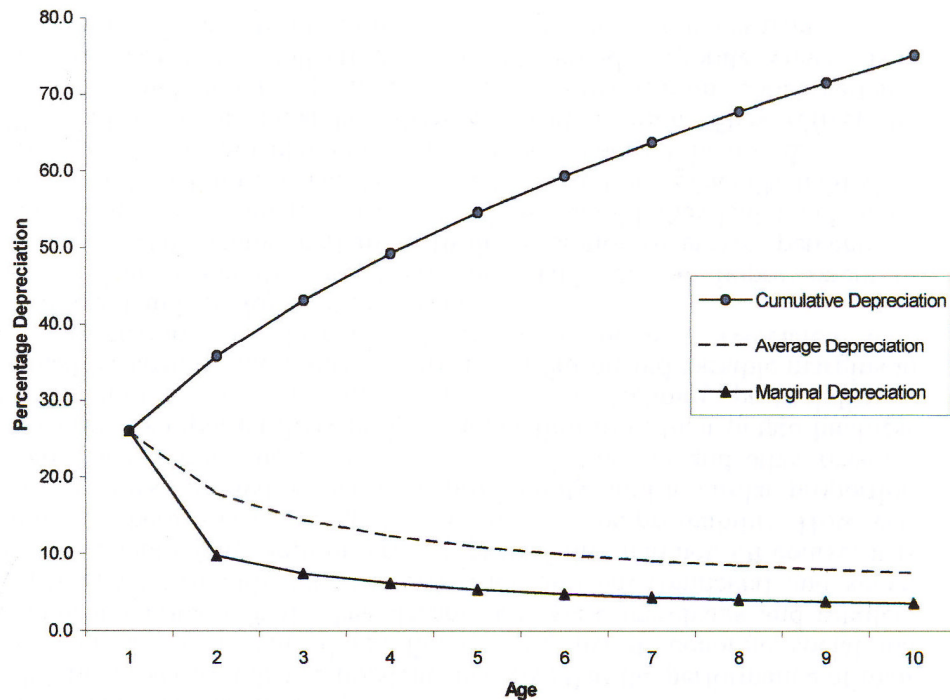
* Indicates significance at the 99% level, γ =correlation coefficient between observed and predicted percentage depreciation.

The parameter estimates of the above model can be interpreted directly. As an example, for a 100 horse-power Case tractor that is in the first year of life and without undertaking any work depreciation is estimated by the intercept plus the coefficient on *Y1* plus the horse-power rating multiplied by the estimated coefficient; $(2.146 + 12.372 + (0.68 \times 100)) = 21.32$ per cent. Once beyond the first year of life the coefficient on *Y1* is no longer included in the calculation, but the coefficient on the *Lnyr* will be accounted for. As *Lnyr* increases by a value of one (approximately equivalent to an increase from 0 to 2.7 years of life (an age of 1.7 years) or from 2.7 to 4.7 years of life) depreciation will increase by 19.94 per cent. Every increase in horse-power rating by ten increases depreciation by 0.68 percent, and for every increase in hours worked by 1000, depreciation increases by 2.1 percent. Thus as years of life, horse-power rating and hours worked increase depreciation increases and this reinforces the findings from other studies (e.g. Cross and Perry, 1995). With more detailed and historical information about manufacturer discount rates it would have been possible to draw firmer conclusions about the differences in depreciation across tractor manufacturers. However, on the basis of the calculations and assumptions regarding the manufacturer discounts as detailed above, John Deere and JCB do not differ significantly in percentage depreciation from Case. By contrast tractors of Massey-Ferguson, Ford/New Holland and "other" manufacturers have respective depreciation of 6.19, 6.65 and 2.54 per cent greater than Case. The caveat to these results being based upon the discount assumptions and calculations is of crucial importance and is an area where further research is required in order to provide a more accurate account of the impact of manufacturer on depreciation. The model explains 84.2 per cent of the variation in depreciation, which compares favourably with other studies (e.g. $R^2 = 0.74$, Wilson and Davis, 1998).

4. Interpretation and Comparability

The following figures provide a graphical representation of estimated depreciation in real terms using the above results and comparing these with standard depreciation estimates. Figure 1 provides the predicted cumulative, annual average and annual marginal depreciation for a representative tractor over the first ten years of its life. This tractor has depreciated by approximately 50% at an age of four and thereafter depreciates at a slower rate with annual marginal depreciation in the region of five to three percent (of new price). Figure 2 compares the cumulative depreciation on the basis of the above results with cumulative depreciation as calculated from two standard sources: Farm Business Survey (FBS) standard assumed rate of annual tractor depreciation of 17% (on a diminishing balance method) and age-dependent depreciation from Nix (2001). Note that the depreciation as calculated from the FBS assumed rate and Nix do not take into account tractor horse-power rating, hours worked or manufacturer. In the example in Figure 2, FBS depreciation rates are lower than those estimated by the model until the age of three, at which point these estimates coincide, whilst from the age of four onwards the FBS estimates are greater than those produced from the model. Depreciation estimated following Nix is always greater than the estimated depreciation from the model. As a further note to compare these three estimates the MAPE from FBS and Nix estimates are 24.77 and 19.76 respectively, compared with the MAPE of 12.37 from the model, each being

*Figure 1. Estimated Cumulative, Average and Marginal Depreciation.
Example of 130HP Case Tractor undertaking 750 Hours Work for Year.*



estimated over 840 observations of tractors up to ten years of age⁶. The MAPE of the model is significantly lower than MAPEs produced from either Nix or FBS estimates. For interest the MAPEs as calculated by Dumler *et al.* (2000) range from 31.4 for the Cross and Perry (1995) Box-Cox model to 82.9 for the general depreciation system method⁷ in their US study for tractors purchased over 1986-1995.

Figure 2. Estimated Cumulative Depreciation Compared with FBS Accounting and Nix Depreciation: Example of 130HP Case Tractor Undertaking 750 Hours Work Per Year.

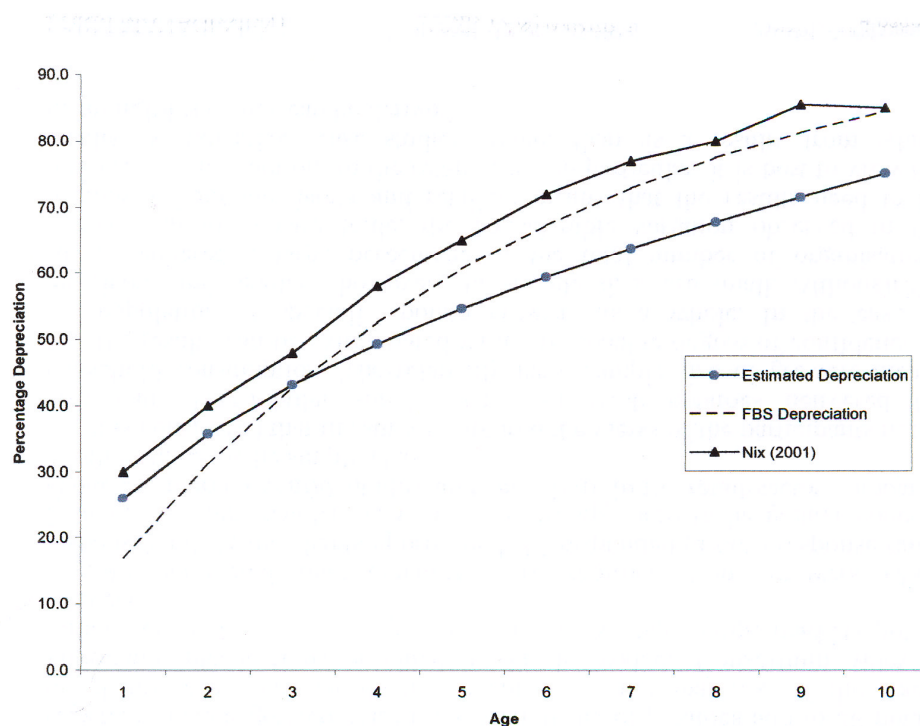


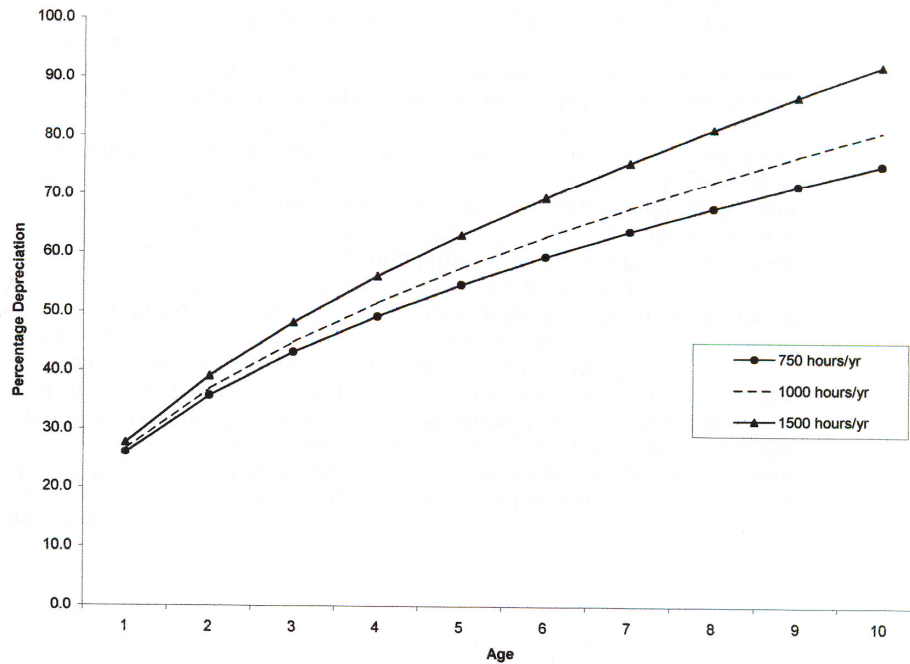
Figure 3 indicates how the hours worked influences the pattern of depreciation from the results of the model. Substantial differences occur in the cumulative depreciation as the tractor ages. As noted above, the standard estimates provided in Nix and used in the FBS fail to account for this level of detail in estimating depreciation.

Standard depreciation rates as given in Nix and used by the FBS provide readily applicable methods for calculating depreciation as a function of the age of the tractor alone. The patterns of depreciation produced by the three methods considered in this section differ, but do follow a common trend of high depreciation in the early years of a tractor's life, with marginal depreciation declining as age increases. The advantage of using the results of

6. The MAPEs have been estimated over tractors up to ten years of age as Nix does not specify a depreciation rate for tractors of more than ten years of age.

7. The general depreciation system allows most of the depreciation to be accounted in the earliest years of a tractor's life for tax purposes.

Figure 3. Depreciation According to Hours Worked: 130HP Case Tractor.



the model as presented here is that a more accurate representation of depreciation can be obtained than would be possible through the use of standard estimates alone. It is of course recognised that this increased accuracy of depreciation requires a greater knowledge of the tractor prior to any calculation or prediction of its depreciation or future value. However, the ease of interpretation of the results of the OLS model facilitates this calculation. Note also that the calculated depreciation above is real-terms depreciation. No account has been taken of the inflationary impact on remaining values.

To enhance the use of the estimated model results in Table 3, the following tables provide estimated trade-in values as a percentage of the discounted new price. These estimated trade-in values are given for Case tractors of varying horse-power undertaking 500, 750 and 1000 hours work per annum in Tables 4, 5 and 6 respectively. Variation of trade-in values according to make of tractor can be made by subtracting the relevant estimated parameter in Table 3 (e.g. for MF subtract 6.188) from the trade-in values given in Tables 4, 5 or 6. As an example of how to use the tables, for a Case tractor undertaking 750 hours per annum the trade-in values are given in Table 5. From Table 5, a 150 horse-power tractor being sold aged 4 years is estimated to have a trade-in value of 49.3% of the discounted new price. Tables 4, 5 and 6 therefore provide a reference for estimating a wide range of trade-in values according to age, hours worked and horse-power rating.

Table 4. Estimated trade-in value in real terms as a percentage of discounted new price for Case tractors undertaking 500 hours of work per annum.

HP	Age when sold										
	0	1	2	3	4	5	6	7	8	9	10
50	82.1	79.6	70.4	63.7	58.2	53.5	49.3	45.6	42.2	39.1	36.1
75	80.4	77.9	68.7	62.0	56.5	51.8	47.6	43.9	40.5	37.4	34.4
100	78.7	76.2	67.0	60.3	54.8	50.1	45.9	42.2	38.8	35.7	32.7
125	77.0	74.5	65.3	58.6	53.1	48.4	44.2	40.5	37.1	34.0	31.0
150	75.3	72.8	63.6	56.9	51.4	46.7	42.5	38.8	35.4	32.3	29.3
175	73.6	71.1	61.9	55.2	49.7	45.0	40.8	37.1	33.7	30.6	27.6
200	71.9	69.4	60.2	53.5	48.0	43.3	39.1	35.4	32.0	28.9	25.9
250	68.5	66.0	56.8	50.1	44.6	39.9	35.7	32.0	28.6	25.5	22.5

Note: An age of 0 indicates that the tractor is in its first year of life and has undertaken no hours of work. Total hours of work are given by the age multiplied by number of hours undertaken per year (e.g. a tractor aged 1 when sold is assumed to have undertaken 500 hours). HP = horse power.

Table 5. Estimated trade-in value in real terms as a percentage of discounted new price for Case tractors undertaking 750 hours of work per annum.

HP	Age when sold										
	0	1	2	3	4	5	6	7	8	9	10
50	82.1	79.1	69.4	62.1	56.1	50.8	46.2	42.0	38.0	34.4	30.9
75	80.4	77.4	67.7	60.4	54.4	49.1	44.5	40.3	36.3	32.7	29.2
100	78.7	75.7	66.0	58.7	52.7	47.4	42.8	38.6	34.6	31.0	27.5
125	77.0	74.0	64.3	57.0	51.0	45.7	41.1	36.9	32.9	29.3	25.8
150	75.3	72.3	62.6	55.3	49.3	44.0	39.4	35.2	31.2	27.6	24.1
175	73.6	70.6	60.9	53.6	47.6	42.3	37.7	33.5	29.5	25.9	22.4
200	71.9	68.9	59.2	51.9	45.9	40.6	36.0	31.8	27.8	24.2	20.7
250	68.5	65.5	55.8	48.5	42.5	37.2	32.6	28.4	24.4	20.8	17.3

Note: An age of 0 indicates that the tractor is in its first year of life and has undertaken no hours of work. Total hours of work are given by the age multiplied by number of hours undertaken per year (e.g. a tractor aged 1 when sold is assumed to have undertaken 750 hours). HP = horse power.

Table 6: Estimated trade-in-value in real terms as a percentage of discounted new price for Case tractors undertaking 1000 hours work per annum

HP	Age when sold.										
	0	1	2	3	4	5	6	7	8	9	10
50	82.1	78.5	68.3	60.5	54.0	48.2	43.0	38.3	33.8	29.6	25.6
75	80.4	76.8	66.6	58.8	52.3	46.5	41.3	36.6	32.1	27.9	23.9
100	78.7	75.1	64.9	57.1	50.6	44.8	39.6	34.9	30.4	26.2	22.2
125	77.0	73.4	63.2	55.4	48.9	43.1	37.9	33.2	28.7	24.5	20.5
150	75.3	71.7	61.5	53.7	47.2	41.4	36.2	31.5	27.0	22.8	18.8
175	73.6	70.0	59.8	52.0	45.5	39.7	34.5	29.8	25.3	21.1	17.1
200	71.9	68.3	58.1	50.3	43.8	38.0	32.8	28.1	23.6	19.4	15.4
250	68.5	64.9	54.7	46.9	40.4	34.6	29.4	24.7	20.2	16.0	12.0

Note: An age of 0 indicates that the tractor is in its first year of life and has under taken no hours of work. Total hours of work are given by the age multiplied by number of hours undertaken per year (e.g. a tractor aged 1 when sold is assumed to have undertaken 1000 hours). HP = horse power.

5. Discussion and Conclusion

The results of the preferred model have been shown to provide a significantly more accurate representation of depreciation than standard methods for calculating depreciation, albeit that this is at the expense of a need for more information on each individual tractor. The main caveat to this approach to estimating depreciation lies in the need for more accurate information on the discounts offered by manufacturers. It would be helpful for any future studies to develop a time series of discounts offered by manufacturers. Moreover, as the results of this study indicate, approximately 16% of the variation in depreciation remains unexplained by the preferred model. Developing a method for accounting for the care and condition of individual tractors, along with information on specialist or additional equipment would help to provide a better representation of depreciation.

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CONFERENCE PAPER

**IMPROVING THE DESIGN OF KNOWLEDGE TRANSFER
STRATEGIES BY UNDERSTANDING FARMER
ATTITUDES AND BEHAVIOUR ¹**

*C. Garforth, T. Rehman, K. McKemey, R. Tranter, R. Cooke, C. Yates, J. Park
and P. Dorward.*

An analysis of the knowledge and attitudes of livestock farmers in South West England towards methods of improving heat detection, sowing clover and optimising the use of slurry shows significant variation between farm and farmer types. The results are used to suggest content, appeal and channels for communicating with farmers about new technology.

Key words: behaviour, farmers attitudes, technological transfer.

Introduction

There is a widespread view that new technology and the research-based knowledge from which it is derived are not being taken up at an appropriate rate by UK livestock farmers. At the supply end of the process, this view is manifest in questions over value for money invested in scientific research. At the demand end, it has raised questions over the efficiency of the mechanisms in place for linking farmers with new knowledge and technology (Garforth, *et al.*, 2003). Recorded differences in financial performance of livestock farms suggest a “potential payback to improved knowledge transfer, not only to bring the bottom third up to average performance, but also to ensure that the top third performers continue to exploit scientific and technological advances” (ADAS, *et al.*, 2002).

Concern has prompted action. The government’s Action Plan for Farming (MAFF, 2000) committed one million pounds over 18 months “for knowledge transfer to improve the flow of outputs from research to the agricultural industry”. The Action Plan had short-term objectives of bringing relief to the sectors most severely affected by the economic crisis hitting the industry at the time and a longer-term objective of supporting adaptation and restructuring. Enhancing knowledge transfer was seen as contributing to both. Three Knowledge Transfer Initiatives (KTIs) were set up, including one for the livestock sectors (ADAS, *et al.*, 2002), which ran from January 2001 to May 2002. The Livestock KTI consulted widely within the industry and distributed factsheets on 67 priority topics, which were well publicised through shows, meetings, intermediaries such as veterinary practices and the farming press. Despite these efforts, awareness of the KTI among livestock farmers was limited and very few accessed the factsheets (Iles, 2003). More recently, a Demonstration Farm pilot project (Defra, 2002) has been set up as part of a Learning, Skills and Knowledge programme within the English Rural Development Programme, which seeks to build on the perceived success of the Monitor Farm Programme in New Zealand (Riddell, 2001). Defra (The

1. This paper was presented at the Institute’s Farm Management Conference, November 19th & 20th, 2003, Bedford.

Department for Environment, Food and Rural Affairs) has also sponsored workshops and consultations to share experience and develop a strategy for knowledge transfer.

The overall aim of the present study was to develop strategies to improve the targeting of knowledge and technology transfer. 'Targeting' in this context meant identifying content, methods and sources for promoting specific technologies and knowledge among specific categories of livestock farmer.

Uptake and adoption of innovations

The adoption of agricultural innovations has been researched extensively since the landmark study of the uptake of hybrid corn in Iowa (Ryan and Gross, 1943). The literature identifies a large number of factors which may be associated with the level and rate of uptake of a technology in any particular situation (Rogers, 1995). They include characteristics of the technology (divisibility, visibility, compatibility, similarity with existing technology); socio-economic characteristics of the farming unit (land tenure, family cycle, relative importance of farming in the household's livelihood, labour situation); physical attributes of the farm holding (size, fragmentation, land quality); personal and psychological attributes of the key decision-maker within the farming unit (age, education, attitude to risk); and perception and future expectations of the economic climate. The relative influence of these factors differs between types of farm and enterprise, and over time (van den Ban and Hawkins, 1996). A weakness of much of the research carried out in this tradition, and therefore of the diffusion models based thereon, is a "pro-innovation bias" (Rogers, 1995): the implicit assumption that all decision making units in a given population – UK dairy farmers, for example – will (or should) eventually adopt the innovation in question.

Adoption studies have generally treated decisions about the use of new technology as events or outcomes, using a cross sectional research design to identify features which distinguish between farms and farmers that take up the technology from those that do not (e.g. the recent study by Burton *et al.*, 1999). Other studies have highlighted the importance of the decision making process itself (Öhlmer *et al.*, 1998) and the role within that of socio-economic and psychological factors (Perkin and Rehman, 1994). Öhlmer *et al.* used a case study approach to explore how farmers in Sweden reach decisions. They distinguished between "intuitive" and "analytical" decision makers. The former make decisions on the basis of their expectations, which they update in the light of their farms' performance and other farmers' experience; the latter are more likely to identify options, calculate the consequences, and make a decision based on a structured comparison of potential outcomes. These studies highlight that when making decisions, farmers take into account what other people, including other farmers, think and do (Cooke *et al.*, 2001).

Decisions require information. The quality, relevance and accessibility of information are key factors in facilitating the rapid uptake of new knowledge and technology. Farmers are exposed to multiple sources of information, to which they attribute different degrees of credibility and perceived influence (Garforth and Norrish, 2000). Farmers' objectives also

vary. Although farm management models often assume objectives to be primarily financial or economic, in reality farmers are motivated by a range of factors (Willock *et al.*, 1999). Objectives, and farmers' assessment of how best to achieve them, are likely to be particularly complex at a time of uncertainty within the industry, when many farmers are asking themselves serious questions about their future and the future of their farms. Understanding farmers' decision making about new technology requires an approach that can handle this complexity.

The present study used the Theory of Reasoned Action (TORA) (Ajzen and Fishbein, 1980) as a theoretical framework to explore farmers' decision making about the use of technology². In the TORA framework, the immediate antecedent of behaviour which is under volitional control is behavioural intention. This is influenced by two main factors: attitude and subjective norm (which is essentially the social pressure felt by the individual to behave or not behave in a particular way). Attitudes depend on a combination of the individual's belief that a particular behaviour will lead to a particular set of outcomes (outcome beliefs) and the values he or she attributes to those outcomes; while subjective norms are a function of the individual's normative beliefs regarding how they feel other people ('salient referents') would expect them to behave, and their motivation to comply with these 'others' (Figure 1).

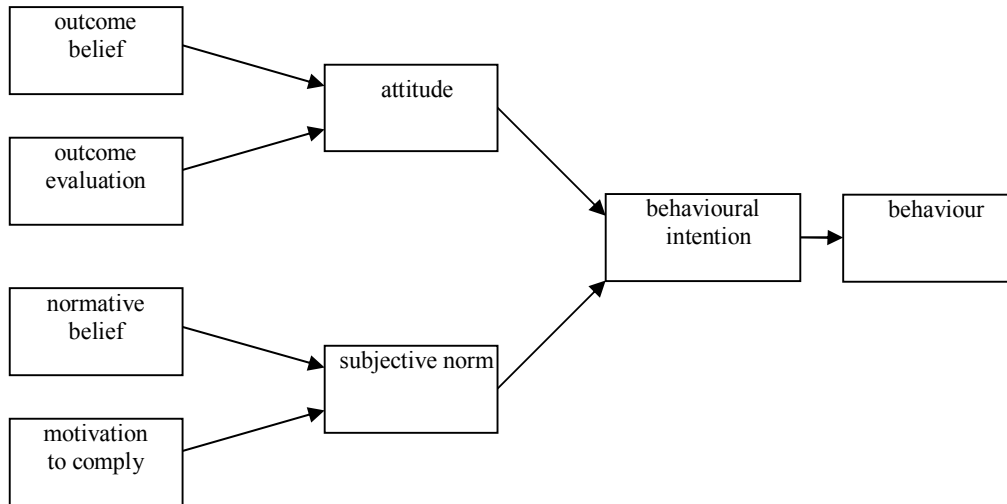
TORA therefore allows us to identify the cognitive and social psychological factors which influence behaviour. The analysis can then be used to suggest interventions to target specific factors which have a strong influence on decisions, and suggest which sources of information or influence to work through most effectively to reach particular categories of decision maker.

The Theory of Reasoned Action has been used as an analytical framework which explicitly recognises the importance of the influence of the actions and behaviour of others, as well as the attitudes and perceptions of the decision maker. Studies relevant to agricultural decision making which have used the TORA framework³ include those relating to (a) environmental conservation management (Kiely-Brocato *et al.*, 1980; Korsching and Hoban, 1990; Carr and Tait, 1991; Beedell, 1996; McKemey, 1996; Batchelor *et al.*, 1999; Beedell and Rehman, 1999; Bennett *et al.*, 1999; Willock *et al.*, 1999; Beedell and Rehman, 2000; Zubair, 2002), (b) soil conservation issues (Napier *et al.*, 1984; Lynne and Rola, 1988; Lynne *et al.*, 1988; Duff *et al.*, 1991), (c) pest management problems (Tait, 1983; Fernandez-Cornejo *et al.*, 1994; Heong and Escalada, 1999; Hassan, 2002) and (d) knowledge and technology transfer for subsumption into farmer practice (Batchelor *et al.*, 1999; McKemey and Sakyi-Dawson, 2000; McKemey *et al.*, 2002; Rehman *et al.*, 2003).

2. The application of TORA to analysis of business decisions is discussed in more detail in Rehman *et al.* (submitted).

3. Some of the studies cited here have used a modification of TORA, known as the Theory of Planned behaviour, which takes account of situations where volitional control over the behaviour in question is thought to be weak.

Figure 1. Schematic representation of Theory of Reasoned Action.



Methods

The study focused on the Southwest of England, a region which encompasses much of the diversity of the English dairy, beef and sheep sectors. The region includes about 20 percent of England's farmland and about 32 percent of the grassland. Of the total holdings in the region, 11,000 were classed as mixed, 6,000 dairy and 12,500 sheep holdings. The agriculture of the region is dominated by relatively small, mixed or pure livestock farms with about two million livestock units. At the time the research began, farming in the region was facing a serious crisis. Jobs were being lost not only among farm workers, but also among those linked with agriculture, from machinery and feed suppliers to hauliers. The strength of sterling and lower world commodity prices had deepened the crisis. Hill farmers were the worst hit, with government figures showing incomes for hill sheep and cattle farmers falling to an average of just £2,000 a year.

Technologies and the knowledge associated with them were identified through a process of reviewing recent scientific literature and the farming press, and discussions with key informants in research institutes, Defra, Environment Agency, MDC and MLC. This led to the selection of three behavioural domains which were broken down into discrete behaviours (Table 1).

The Theory of Reasoned Action requires data collection in two distinct phases. The first involves qualitative research to identify *salient outcome beliefs* and *social referents* with respect to a specific behavioural domain. Three focus group discussions – one for each technology – were arranged through the good offices of the Duchy College, Cornwall, and Cannington College, Somerset. These were complemented by telephone interviews with 75 farmers from the region selected at random from the Yellow Pages. Both the focus groups and the interviews asked farmers about their social referents as well as exploring their salient outcome beliefs regarding the behavioural

domain and the specific behaviours relevant to the technology in question.

Figure 1. Selected technologies and behaviours

Behavioural domain	Technology	Related behaviours
Introduction of white clover	The inclusion of white clover in grassland to enhance the feed quality of forage/grazing and/or as a Nitrogen supplement	Practices designed to introduce white clover into the grassland management system and to manage existing grassland to encourage white clover
Farm waste management	Optimising N inputs by management of farm waste, thereby adhering to the relevant Defra Code of Good Practice	The replacement of chemical fertilisers with slurry and/or farmyard manure (FYM)
Oestrus detection	Technologies for increasing heat detection rates in dairy cows	Following specific recommended observation times; using on-farm Milk Progesterone Testing kits; installing a pedometer based computer system

The second phase of TORA data collection is the application, to a random sample from the population, of a structured questionnaire which incorporates statements derived from the first phase. This is commonly done through face to face interviews. For the present study, the method was adapted to a postal survey.

The material from the focus groups and telephone interviews was incorporated into a draft questionnaire which then went through a pre-pilot and finally a formal pilot stage with 150 farms drawn from the main sample. Questions relating to previous practices were in the form of multiple response tick boxes. Level of satisfaction with those practices was then sought on a 5-point bi-polar scale; very satisfied (+2) to very unsatisfied (-2). Future intentions were recorded in the same way, eliciting strength of intention to change practices over the next twelve months. Beliefs and outcome evaluations were measured through the level of agreement/disagreement with sets of statements derived from the qualitative research on a bi-polar five point scale (+2 = strongly agree to -2 = strongly disagree). Subjective norms were measured through questions on the level of motivation to comply with each of a set of sources identified through focus groups, ranging from very motivated (+2) to not at all motivated (-2), and the extent to which each of the sources would support the use of each technology.

A stratified random sample of 1650 holdings in Cornwall, Devon and Somerset was provided by Defra Statistics. There were 550 each of mainly dairy, mainly sheep and mainly beef holdings of which 50 of each category were used for the pilot survey. The postal survey began on September 19th 2002, with a first reminder sent on October 17th 2002, and a final reminder and repeat questionnaire dispatched on November 14th 2002. The overall response rate was 29.3%.

Results⁴

Adoption

Current usage of the technologies (i.e. in the past year) ranged from between 1.5 and 10 percent for the three heat detection techniques (pedometers, milk progesterone testing, and recommended observation times) to around 30 per cent for the deliberate encouragement of white clover in pastures, and 54 per cent for reliance on slurry and/or FYM as the main source of N. In the latter case, however, there was little evidence of a deliberate effort to optimise the use of N from this source. These data confirm the general impression of low rates of uptake of knowledge whose application, according to research, should be beneficial to precisely those types of farms selected into the three respective samples. Projected increases in adoption in the short term, based on comparison between current usage and stated intention to change behaviour in the next year, are also low.

Attitudes

Attitudes were measured by summing the products of outcome beliefs and outcome evaluations for each respondent in respect of each behaviour. While attitudes generally towards the use of white clover and to optimising the N available in slurry and FYM are positive (and strongly so for white clover), those towards heat detection methods are much weaker. There is a strong prevailing view among dairy farmers that their own experience and stockmanship are sufficient for effective heat detection, and that to suggest otherwise is to demean their expertise and thus possibly their self esteem.

Barriers and drivers

Barriers were identified from those individual outcome attitudes (outcome belief x outcome evaluation) which were significantly and negatively correlated with behavioural intent; drivers were identified from outcome attitudes which were significantly and positively correlated with behavioural intent. Table 2 summarises the main cognitive barriers and drivers for each technology, noting any differences between sub-sets within the samples. This shows that financial considerations have an influence in all three technology areas, but that perceptions of technical performance, ease of use and compatibility with the resources and constraints of the farm also have an effect on behavioural intent. There are specific differences between categories of farmer. Women, for example, are influenced more than men by their perception of consumer preference for produce grown using organic sources of N, while men's views on potential yield loss and pollution problems are more likely to deter them from increasing their reliance on slurry and/or FYM.

4. Full stand-alone reports of the analysis for each technology are available as separate documents (McKemey, 2003a, McKemey, 2003b, McKemey and Yates, 2003) The overall findings are reported in Garforth *et al.*, 2003.

Table 2. Cognitive barriers and drivers identified from the TORA Analysis

TECHNOLOGY	WHOLE SAMPLE	SUB-SETS
Heat detection (1).MDC Observation times.		
Barriers	None	<i>Organic</i> : fitting the system; ease of management <i>Under 40 years</i> : appropriate for untrained staff
Drivers	(in decreasing order of importance) Cost effectiveness Improved heat detection rates Improved conception rates Effective for silent heats	<i>Female</i> : reduced labour demand; ease of management <i>Smallholders</i> : can be used year round; improved heat detection rates <i>Current users</i> : fits the system; ease of management <i>Tenant farmers</i> : improved heat detection rates; improved conception rates
Heat detection (2) Milk progesterone testing (MPT)		
Barriers	None	None
Drivers	None	<i>Current users</i> : effective for silent heats; cost effectiveness; reduced labour demand <i>Mixed tenure</i> : ease of management; effective for silent heats; improved heat detection rates
Heat detection (3) Pedometers		
Barriers	None	<i>Organic</i> : can be used year round
Drivers	(in decreasing order of importance) Effective for silent heats Improved heat detection rates	<i>Organic</i> : reduced labour demand <i>Mixed dairy/arable</i> : improved conception rates
White clover		
Barriers	(in decreasing order of importance) Sensitivity to soil pH Makes weed control difficult Only contributes N in warmer months Leads to later silage cuts Still need to apply N in Spring	
Drivers	(in decreasing order of importance) Helps fix soil nitrogen Increased forage quality Decreased concentrate use Financial advantage Increased live weight gain	<i>Recent experience of WC</i> : fills gaps in the sward; increased grass production
Optimising N from slurry/FYM		
Barriers	Reduced forage yields	<i>Large scale</i> : unpleasant/dirty task; can only spread Spring to Autumn; corrodes machinery; reduces yields; inconsistent nutrient value <i>Male</i> : reduced yields; increased pollution <i>Female</i> : none
Drivers	(in decreasing order of importance) Cost savings Appropriate for forage crops	<i>Organic</i> : improved grazing quality; improved soil fertility; increased drought resistance <i>Female</i> : cheaper than chemicals; public preference for goods produced using slurry/FYM

Subjective norms

Subjective norms were calculated as the sum of the products of normative beliefs and motivations to comply for the various referents identified in the questionnaire. Overall, correlations between attitudes and behavioural intent are stronger than those between subjective norms and behavioural intent. This is particularly the case for heat detection, where farmers' own experience is a much stronger influence than any of the social referents identified from the focus groups and telephone interviews. This suggests that technology and knowledge transfer should focus on addressing outcome beliefs and evaluations rather than elements of the subjective norms. However, differences in the degree to which farmers are motivated to comply with the various referents can be used to suggest channels and sources which are likely to have a greater impact.

Institutional referents in several instances register a particularly low level of influence: this is because the average motivation to comply with their perceived views is negative. MDC, for example, seems to have little influence on farmers' decisions in respect of heat detection methods: while respondents acknowledge that MDC has views about what they should do, they do not feel a strong motivation to comply with those views. There are similar findings for Defra in respect of white clover and, with younger farmers, in respect of optimising N; and for colleges and universities, with farmers who are not members of organisations, in respect of optimising N. Social referents with relatively high levels of influence on intentions are vets and AI services (for heat detection technologies), other experienced farmers and the farming press.

Implications for knowledge and technology transfer

General considerations

Knowledge and technology transfer is more than ensuring that people are aware of and know particular 'facts' about a technology. Knowledge includes subjective elements such as perceptions, beliefs, attitudes and values. Believing that a new technology is good for the farm is more important in the decision whether or not to use it than knowing the science behind it or the results it has achieved in other contexts. As well as being the vehicle by which people learn what others want to tell them, communication is the process by which these subjective elements of knowledge are formed (Garforth, 2004).

A knowledge and technology transfer strategy is essentially a communication strategy for a specific purpose. Three key decisions in designing such a strategy relate to the audience, the appeal and the channel through which information reaches the intended audience. Before exploring these, however, we touch on two matters, the first an important ethical concern and the second a word of caution about our expectations of the power of communication.

Social psychology models have been widely used in commercial advertising to identify "appeals" and sources, based on an analysis of attitude and subjective norm components respectively, that are likely to reinforce or

change the behavioural intent of distinct audiences towards particular products. The motivation here is to boost company profits by increasing the amount of the product that consumers buy. Advertisers try to influence what consumers believe about the product: that there is a strong incentive to exaggerate or mislead is shown by the fact that governments find it necessary to introduce regulations governing what can and cannot be claimed in commercial advertising. With agricultural R&D funded by industry levy or the public purse, the underlying objective of technology transfer is to benefit the farmer and/or the population at large. A TORA analysis may show that farmers disagree with researchers' perceptions about the merits of a particular technology. If, for example, farmers do not believe that the technology will be labour saving, researchers should revisit their earlier conclusions relating to labour requirements, from the perspective of the reality of farm businesses, before trying to devise clever advertising or demonstrations to convince farmers otherwise.

The second point to stress is that planned communication, on its own, can have only a limited effect. The effect will be greater to the extent that other elements within the decision maker's environment make it easy to follow through the decision to behave in a particular way. Availability of a product or service, and access to after sales advice and support, can support a decision to change and thereby reinforce the effect of any communication strategy to promote a technology. Legislation and associated sanctions also have their part to play: perception of the possibility of infringing pollution regulations, for example, is an important factor in some farmers' decisions about the use of slurry and farmyard manure. Any strategy for knowledge and technology transfer therefore needs to assess the extent to which these other factors will be conducive or not to farmers' acting on what they learn through communication. The economic situation of the agricultural sector is obviously one such factor. In this respect, a major advantage of combining PosMP⁵ modelling with TORA is that it injects realism based on the resource constraints and economic parameters facing the farm into behavioural predictions based on changes in the TORA elements which predict behavioural intent.

Audience, content and appeal

TORA analysis indicates the different appeals and sources that might be appropriate to use for different farm type and social categories, in the same way that market research in the commercial sector segments audiences for different advertising and promotion treatments. The relative influence of attitude and subjective norm on behavioural intention is one consideration. If the TORA analysis shows that intention is more strongly influenced by attitudes than by subjective norms, promotion of the technology should focus on reinforcing those beliefs that are identified as drivers and combating those which are barriers. For example, the suggestion that MDC observation times allow farmers to substitute unskilled labour for their own herd management

5. In a subsequent part of the study, a set of farm models was constructed using Positivistic Mathematical Programming (PosMP) to predict levels of future adoption of technologies.

expertise is not one that is likely to appeal to dairy farmers. More sensible would be to provide data which demonstrate the relative cost-effectiveness of the method and to stress that the recommendations complement and enhance rather than substitute the farmer's expertise. Where subjective norms are the more significant determinant, then promotion should portray the views of those referents whom the analysis shows to be particularly influential, or seek their endorsement of the proposed technology. It can however be effective only if the views of referents are supportive of the proposed technology.

Where the views of influential social referents are not supportive of the technology, the communication strategy should include a deliberate targeting of these with content that addresses their own reservations. Indeed, it could be argued that when the normative element is clearly dominant and attitudes have little influence, possibly due to a lack of previous experience or knowledge regarding the technology in question, these referents become the more important element within the proposed audience. This has certain implications for the development of appropriate communication strategies: in particular, the content of messages has to be pertinent to the opposing influential referents. This in turn implies a need to understand the opinions of these referents regarding the technologies.

The TORA analysis in the present study suggests that attitudes have generally a stronger influence than subjective norms. Knowledge and technology transfer strategies should therefore concentrate on addressing the cognitive barriers and drivers which have the most influence on behavioural intent on different farm and social categories in respect of the three technologies rather than trying to induce a change in subjective norms.

Table 3. Possible content and appeals for knowledge and technology transfer.

Technology	Audience	Content/appeal
Heat detection-MDC observation times.	Organic farmers	Observing at recommended times can be managed easily within an organic system
	Female farmers	Other farmers' experience is that the observation times reduce labour demand overall and can easily fit within the normal herd management routine
	All dairy farmers	Experienced farmers have found that it is cost-effective and increases conception rates, complementing their own expertise
White clover in pastures	All sheep farmers	Farmers have found they have been able to manage later silage cuts; successful strategies for weed control in clover-enhanced pastures
	No recent experience of white clover	Clover-enhanced pastures and forage give higher LWG and are more palatable
Optimising N from slurry/FYM	All beef farmers	When properly managed and used, slurry/FYM need not lead to reduced forage yields
	Large scale farms	Inconsistent nutrient quality can be managed through testing and adjusting application rates

Examples of possible appeals, based on the TORA analysis, are shown in Table 3. This is not intended to be a comprehensive set, but indicative of the way the analysis can be used to identify specific content and treatments within a communication strategy.

Sources and channels

The TORA analysis of subjective norms is most useful in deciding how to channel information for knowledge and technology transfer to the audience. With respect to heat detection, for example, veterinary surgeons – not coming to the farm specifically to advise on heat detection, but in the normal course of their work – are seen, together with other experienced farmers, to have the greatest potential to influence farmers' decisions on using MDC observation times. Placing stories in the farming press about how experienced farmers have found the observation times to complement their own expertise, and circulating to vets in dairying areas well-designed briefing documents on the research evidence relating to observation times, should therefore be part of any strategy to promote this technology.

More generally, other experienced farmers working within the same resource constraints are the most commonly identified influential referents for the three technologies. Other referents are influential for some categories of farmer and for some technologies, but less so for others. For example, the farming press is influential for older farmers with respect to white clover in pastures, while for large-scale beef operations the press is a negative referent in respect of managing slurry/FYM. Farmers who do not belong to farming organisations or associations are particularly difficult to influence through referents apart from other farmers: even local agricultural colleges, which are viewed positively by other farmers as referents for managing slurry/FYM, are seen negatively by those who are not members of organisations.

Institutional referents should be particularly cautious about promoting themselves prominently as champions of technologies: the analysis suggests that farmers do not feel motivated to comply with the views of MDC regarding heat detection, or with those of Defra regarding white clover.

Conclusions

The research reported here had its origins in concerns about the slow uptake of technologies that seem to offer potential benefit to farmers. The analysis suggests that TORA can help R&D agencies target their knowledge and technology transfer more effectively.

The findings confirm that attitudes towards a technology have a strong influence on whether or not farmers intend to adopt it. Carefully planned communication can help to reinforce attitudes which support adoption and counteract those which act as barriers. Attitudes vary between farm and farmer types. Strategies for knowledge transfer should therefore be tailored to the specific technology and audience. The farming press and local colleges, for example, are suitable channels for promoting white clover among sheep farmers, while content should highlight that other farmers have been able to adjust timing of silage cuts to maximise the benefit and have developed

successful strategies for weed control. For methods of improving heat detection, the vet is regarded as a highly credible source of advice: any promotion, however, should highlight how the technology enhances rather than displaces the farmer's own herd management expertise. With optimising N from slurry/FYM, promotion will need to convince large-scale beef farmers that inconsistent nutrient quality can be managed through adjusting application rates in response to testing. Local and personal contacts generally have more influence on farmers' intentions than more distant and impersonal sources. In particular, many farmers are not disposed to follow advice from institutions that they feel do not fully understand their situation: this is the case for MDC regarding heat detection and for Defra regarding white clover.

Further research will be needed to show whether communication strategies informed by this analysis do in fact result in an increase in the rate of uptake.

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CONFERENCE PAPER

INTEGRATING FLOOD MANAGEMENT AND AGRI-ENVIRONMENT THROUGH WASHLAND CREATION IN THE UK¹

*Morris J, Bailey A P, Alsop D, Vivash R M, Lawson C S,
and Leeds-Harrison P B.*

In many river floodplains in the UK there has been a long history of flood defence, land reclamation and water regime management for farming. In recent years, changing policies with respect to farming, environment and flood management are encouraging a re-appraisal of land use in rural areas. In particular, there is scope to develop, through the use of appropriate promotional mechanisms, washland areas which will simultaneously accommodate winter inundation, support extensive farming methods, deliver environmental benefits, and do this in a way which can underpin the rural economy. This paper explores the feasibility of flood storage and washland creation, the likely economic impacts of this type of development, and the financial and institutional mechanisms required to achieve implementation. The outcome is the identification and assessment of a washland package within the UK agri-environment framework. However, given the diversity of circumstance and practice, it is suggested that a range of options, and not just those associated with management agreements and annual payments, is used for the management and administration of washland areas.

Key words: flood defence, water management, land use, washland areas, rural economy, agri-environment.

Introduction

In many river floodplains in the UK there has been a long history of flood defence, land reclamation and water regime management for farming. In recent years, however, the limits of these floodplains has been demonstrated by fluvial floods during the winter months (English Nature, 2001). This has encouraged a re-appraisal of land use in rural areas encompassing farming, environment and flood management. The aim is to find sustainable solutions for the management of water, both during flood events and throughout the year.

Washlands are one mechanism for flood defence and management (Environment Agency, 2002). These are flood storage areas used during times of high flow to reduce flooding in other parts of the catchment (English Nature, 2001). For the purpose here, a washland is defined as an area of the floodplain that is allowed to flood or is deliberately flooded by a river or stream for flood management purposes, simultaneously providing potential for a wetland habitat. (Morris *et al* 2004).

This paper explores how public funds might be used most effectively to achieve better flood moderation through appropriate use of agricultural land within a catchment in a way which will reduce the adverse effects of unwanted flooding and simultaneously exploit the beneficial opportunities that the managed storage of floodwaters would bring. These opportunities are explored below. In particular, there is scope to develop, through the use of

1. This paper was presented at the 14th International Farm Management Congress, August 11-15, 2003, Perth, Australia and is reprinted by kind permission of the organisers.

appropriate promotional mechanisms, washland areas which will simultaneously accommodate winter inundation, support extensive farming methods, deliver environmental benefits, and do this in a way which can underpin the rural economy.

Washland Adoption

The adoption of flood storage options will inevitably lead to a change in flooding and water management regimes. The extent of change will vary according to particular site characteristics and the design and operation of the flood facility. Nevertheless, the change in regime is likely to include a change in flooding frequency, duration and depth of winter flooding. In most cases, washland adoption will involve increased incidence of flooding in the flood storage areas, but in other areas existing high levels of flood risk could be alleviated. Changes in winter groundwater levels associated with increased winter flooding, and in some cases the retention of high field water levels at other times may also occur. In other areas, there would be opportunity to relieve excessive water logging.

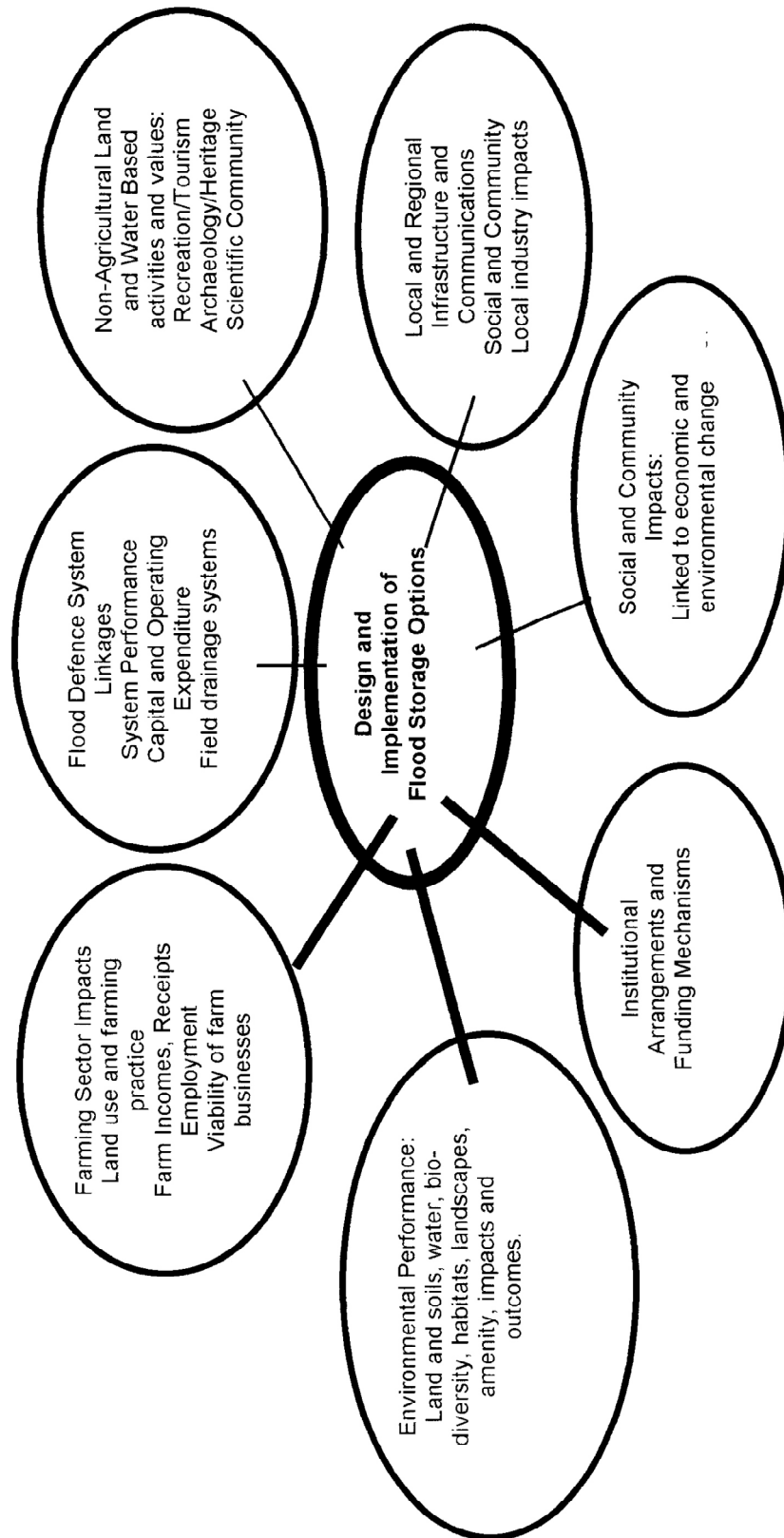
Consequently, a managed and controlled approach to flood storage on designated washlands would help alleviate undesirable flood risks, and at the same time exploit the opportunities that such managed washlands might offer to various stakeholders. The latter include land managers, environmental bodies and those organisations charged with providing flood defence and land drainage services (Figure 1). Of particular interest are the agricultural and environmental impacts and the consequences of the adoption of flood storage options on water regimes, land use, farming practices and incomes, and environmental quality (Morris *et al.*, 2002). These are briefly reviewed below.

First, and given that washlands offer a managed facility, they would alleviate flood damage and disruption borne by those areas currently at risk, as well as incidental flood damage in other areas in all but the most extreme events. They could take pressure off flood defences which protect urban property and infrastructure. They could also reduce the impact of uncontrolled flooding of communications infrastructure and the disruption this causes to economic and social activity, both locally and regionally.

Second, agricultural land use, farming practice and performance are critically dependent on flood defence and land drainage (Dunderdale and Morris, 1997; Morris and Hess, 1987; Morris *et al.*, 2002). This is particularly where flood risk and field water management largely define what is possible. Flooding above and waterlogging below the surface of the land has major implications for land use, farming practices, productivity, value-added, and farm incomes. Generally, the lower the standards of flood defence and drainage, the lower is the intensity and commercial viability of farming. Further, in recent years, flooding has been excessive, to the point where farming futures are threatened. There is scope, through a managed approach to flood storage, to provide relief to those farmed areas worst affected by long duration flooding at the present time, and simultaneously provide new opportunities for washland creation in other areas.

Third, changes in flood regimes will have impacts on environmental

Figure 1. Framework for Economic Appraisal of Flood Storage Options on Washlands



quality. The extent of the impacts will vary according to the degree of change in the water regime, existing or potential environmental features and their sensitivity to changes. Plant communities and wetland birds are deemed to be the main environmental qualities to be protected and enhanced. Species rich plant communities associated with valued and protected habitats are sensitive to prolonged winter flooding and have relatively low tolerance to spring flooding. Conversely, migrant wildfowl enjoy deep winter water and breeding waders require shallow surface flooding during the spring. As a result, there are potential conflicts of interests between environmental components which will require careful management of flooding regimes, especially in the spring period. Nevertheless, the adoption of flood storage options, replacing uncontrolled flooding with managed washlands, provides an opportunity for enhancing existing environmental quality. At the same time however, increased flooding in some areas could, unless purposely controlled, cause damage to existing valued habitats, and frustrate the potential creation of new ones.

The various dimensions of the environment include field and ditch plant communities, birds especially migrant wildfowl and breeding waders, invertebrates, fish and small mammals.

Fourth, tourism and recreational activities may also benefit from a flood regime that served to enhance the wetland characteristics of an area, provided that access and mobility were maintained. The same could be said for the preservation of archaeological remains. However, traditional rural activities, such as peat abstraction and withy (willow) production, may suffer from long duration flooding or permanently high water levels, although these could be relocated beyond the washland areas.

Finally, the flood storage options through washland creation could re-orient capital and revenue expenditure more towards flood 'management' than flood 'defence' *per se*. This would serve to reduce the uncertainty of the impacts of flood events and provide responsible agencies with greater flexibility for flood management. The flood storage options would contribute to sustainable flood management in so much as they could provide a cost-effective basis for reconciling social, economic and environmental objectives within a flood plain.

The remainder of this paper examines the feasibility of flood storage and washland creation, the likely economic impacts of this type of development, and the financial and institutional mechanisms required to achieve implementation.

Feasibility of Washland Creation

Catchments can be classified into a number of zones which vary in terms of topography, hydraulic characteristics and potential contribution to flood storage management. Within this there may be a number of options, for example, creating temporary flood storage areas on farm land in designated storage areas in upper and mid catchment until the peak flow has passed in the floodplain watercourses, or creating new wetland habitats throughout the catchment to intercept and store floodwater during flood events.

The suitability of potential sites for washland creation depends on a large number of factors: technical, economic, environmental and social. However, in the first instance, it is required that a site must work from a hydraulic point of view. Basically storage sites must not only offer the potential of containing worthwhile quantities of flood water, but both the filling and the evacuation must be controllable for sufficient benefit to be achieved. Thus hydraulic potential should be the initial selection criterion followed by other criteria which reflect opportunity for environmental enhancement, and likely social and economic impacts. These are further explained below.

First, in terms of ease of filling, it must be possible to fill the storage zone at the right time and quickly in order to optimise the flood protection benefits. Accordingly the storage site should be close to an arterial river, have internal ground levels well below normal flood level in the river so that it could be filled quickly by gravity, and should require the minimum of engineering works to convey and control the floodwater into the storage zone.

Second, with regard to ease of evacuation, it must be possible to time the evacuation of the storage zone and to do so expeditiously in order to optimise flood protection benefits. Accordingly the site should be close to a suitable outlet path with spare capacity even under flood conditions, have internal ground levels well above normal flood level in the receiving watercourse so that water can be evacuated quickly by gravity, and require the minimum of engineering works to convey and control the floodwater out of the storage zone.

Third, regarding ease of containment, flood water in the storage zone must be effectively contained in order to retain control and also to ensure the safety of adjacent areas. To facilitate this the area should have convenient natural or man-made features already present to delineate the zone (if necessary with improvements). Suitable features could include rising ground, raised floodbanks, highway causeways, or railway embankments. If new embankments are needed, the site will need to have suitable geology and soil types to facilitate this.

Fourth, a site's current susceptibility to flooding needs to be considered. Areas which are currently flooded infrequently offer the greatest potential for providing flood relief benefits, although areas which currently suffer frequent and prolonged flooding, might offer scope for managed flood storage if the evacuation arrangements could be significantly improved.

Fifth, the potential for habitat improvement could be an important factor where environmental enhancement is a key objective. Flood storage and washland creation could involve improvement of existing wetland sites and the creation of new ones. The availability of funding for the development of new flood storage areas is certain to be linked to the achievement of environmental enhancements. Accordingly the following features would assist: the area falls within a designated conservation area; it is physically easy to enhance the habitat; there is scope for reconciling flood storage objectives with environmental objectives, through managed flood and water level regimes; and offers the possibility of up-rating the sites official status for instance by re-designation. However, it is also recognised that adoption of

flood storage options on some species rich sites could potentially damage valued habitats due to untimely or prolonged flooding.

Sixth, current land use needs to be appropriate, in that it could tolerate the regular inundation associated with the storage of flood water. Thus, extensively managed grassland which is lightly stocked would be considered suitable. However, areas of intensive grass or arable production might have to be abandoned. This may give rise to the need for compensation.

Finally, the area should be free from existing infrastructure. Where this is present, the cost of providing protection or relocation should be acceptable. Roads, railways, buildings, buried pipelines, underground and overhead electricity lines, the landward face of raised floodbanks and any land drainage pumping stations would be susceptible to increases in flood frequency and duration. The effect of the stored water on routine access is also important. Inundation of these assets, services and utilities could involve substantial damage costs. The presence of these infrastructural assets reduces the attractiveness of a potential storage site, although it might be feasible to abandon a limited amount of infrastructure, or in other cases protection might be provided at reasonable cost. In many cases, however, the protection or relocation of assets would significantly add to the cost of developing a given flood storage site.

Impacts on the Agricultural Sector

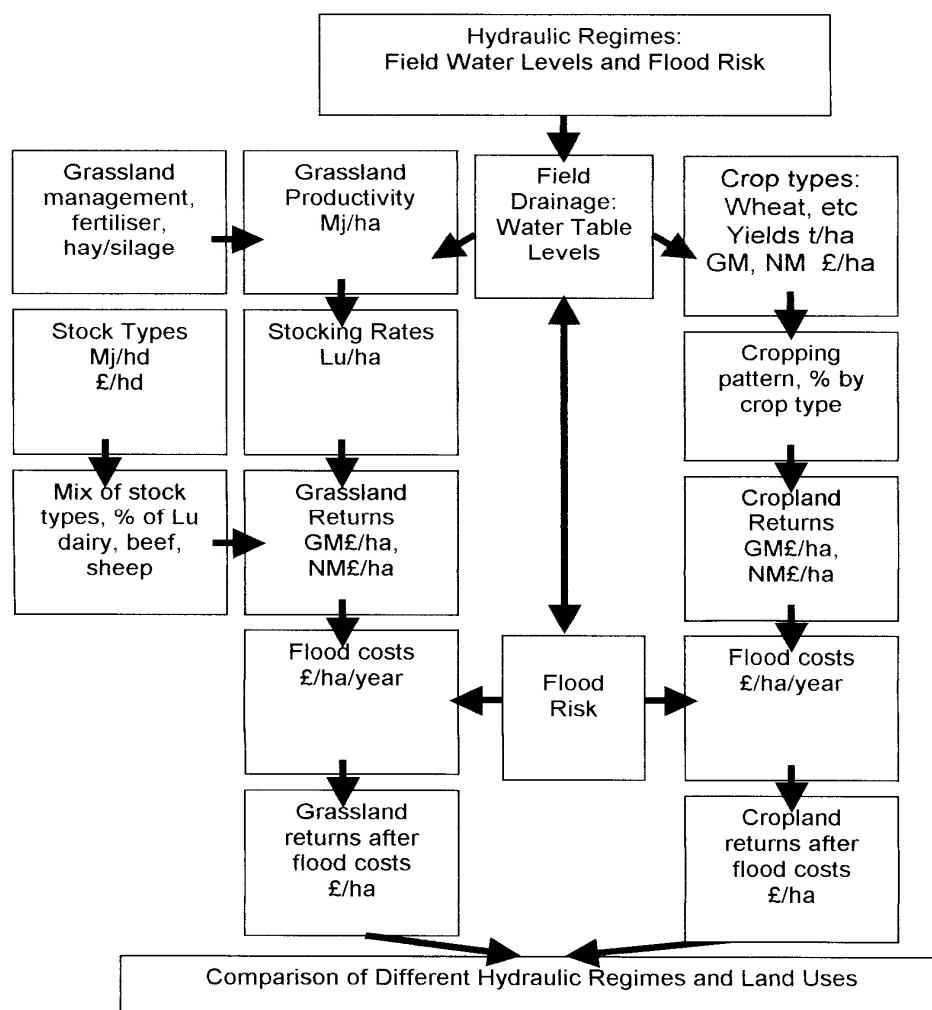
Flood defence for agriculture, as for most land-engaging activities, refers to acceptable levels of flooding above and below the surface of the ground. Acceptable levels of flooding depend on the types of farming activities and practices. Generally, the more intensive the system of production the greater the need for flood defence. Arable systems involving root crops and cereals are considered more sensitive to waterlogging and flooding than grassland systems, whether grazed or cut for winter feed. As a result, floodplain areas within the UK are predominantly down to grass, although where flood risk is low, cereals and maize for fodder are sometimes grown, in some cases assisted by private pump schemes. The agricultural economy resulting from this is primarily based on dairy, cattle and sheep production. Further, regional farm business data suggests that farms within these areas tend to be smaller and less intensive, and therefore generally have lower average farm incomes than their regional average. Although very good performance is possible, many farms operate at lower levels of intensity than either their potential or the regional average. Most of the areas are used for grass conservation and/or stock grazing. The latter mainly involves dry milk cows, beef cattle and sheep. In the drier areas, over-wintering of sheep provides a useful income source. In this context, the relatively extensive system of grassland management provides opportunities to qualify for extensification (under EU Beef and Sheep Premia).

The alleviation of flooding in those areas worst affected will reduce damage costs and increase output and profitability, other things being equal. Conversely, an increase in winter flooding in the newly created washlands would impose restrictions on farming, which, in the absence of incentive payments, would reduce the income and profitability for farmers. The extent to which this occurs depends on the degree of change in flooding and

waterlogging, and the extent to which existing land use is sensitive to this. For example, increasing the extent of flooding, particularly in the spring, on agriculturally productive grassland would result in the development of flood tolerant vegetation such as rush-pasture, inundation grassland or swamps depending on the degree of flooding. Although these communities can provide summer grazing, changes in agricultural practices will be necessary as a result of the change in flood water distribution. Further, flooding depth and duration has obvious impacts for the timing of critical field operations and access. These apply to arable operations such as crop establishment and the grassland management operations such as forage harvesting and turnout dates of grazing animals. Disruption and delay will have an impact on revenues and costs.

The method needed to assess the financial and economic impacts of changes in drainage conditions and flood risk associated with the adoption of flood storage options is summarised in Figure 2 (Morris and Hess, 1987;

Figure 2. Approach to Financial and Economic Appraisal of Washland Options



Penning-Rowsell et al., 2003). First, field drainage conditions should be identified as these determine the physical productivity of farming activity, whether for grassland (energy Mj/ha) or arable crops (t/ha). Energy from grass converts into a potential livestock carrying capacity (livestock units per ha) and, depending on the type and mix of livestock in the floodplain, into financial returns £/ha. Financial returns from arable production (£/ha) reflect the type and mix of crops in the flood plain. Second, therefore, estimates of the financial returns from each enterprise are needed. These are net of relevant production expenses (such as seeds, fertilisers, veterinary expenses and machinery operating costs). They may also include any receipts from government schemes such as Beef and Sheep Premia, IACS area payments, and ESA membership. Third, flood damage costs (£/ha/year), which vary according to flood risk and land use, will need to be identified and deducted from financial returns to give an overall estimate of financial performance (£/ha/year) for each major land use type.

Field drainage conditions determine land use options and the physical productivity of farming activity. Commercial crops are sensitive to waterlogged soils and anaerobic soil conditions during critical growth periods, with consequences for crop yield, quality and value. Wet soils have reduced strength and this reduces their bearing capacity which, in turn, restricts field access by machinery or grazing livestock. This leads to delays in critical field operations such as cultivations and fertiliser application, and to restrictions on grazing seasons. In the case of grassland, wet soils will not provide suitable growing conditions for commercially 'improved' grass species, restrict field access for the early application of fertiliser, and are liable to damage by grazing animals. For these reasons, and other requirements of more intensive livestock husbandry systems such as quality silage-making, persistently wet field conditions tend to be associated with extensive grassland, whether grazing or hay cutting.

In terms of the flood damage costs, these will vary according to the quality of grass, and the duration and depth of flooding. Relatively short duration, even multiple winter flooding on extensive grassland has limited impact. Grassland is very tolerant to winter flooding. However, long duration flooding will destroy grass or result in an overall loss of grassland productivity. The same is true for repeated relatively short duration floods which can be additive. There may also be problems of soil compaction and erosion.

From a farmer perspective, increased flood risk could reduce farm revenues, increase some operating costs and therefore reduce profitability. In some cases, there may be savings in some farm level costs such as regular labour and machinery if a farm moves to a less intensive system. Much depends on farm circumstances, especially whether farms have scope to reduce not only direct costs such as fertilisers but also overhead costs such as labour and machinery and other general expenses in the process of adjustment. Estimates would need to be made regarding the financial revenues and costs for the main livestock and arable enterprises (Morris et al., 2000). A key factor influencing the impact on a farm business of a change in flood risk on any parcel of land is the proportion of the total area of the farm that is accounted

for by this parcel. Generally, the larger is the proportion of the whole farm subject to change in flood defence standards, the bigger is the impact on the whole farm business.

In reality, therefore, arable farming would not be considered feasible on washland areas. There may be a role for dairy systems, although conversion to a beef cow system is more likely to offer a better prospect. For beef and sheep systems, there may be some advantage in switching to less intensive systems, providing savings in overall fixed costs at farm level can be achieved.

Table 1 contains indicative estimates of the reductions in financial indicators associated with the adoption of a wet grassland options on *Table 1. Indicative reduction in financial indicators associated with a switch from typical grassland or arable land use to extensive grazing under a washland regime*

£/ha/yr Reductions 2001 values **	Dairy	Beef	Beef and Sheep	'Average' catchment Dairy and Livestock	Arable
Gross Margin (before forage crops)	410	280	260	350	300
Gross Margin (after forage costs)	330	190	170	260	300
Net margin after semi fixed costs. ***	215	140	100	170	150
Net margin after full fixed costs ****	150	80	0	90	90

washlands in South West England (Morris et al., 2002). These vary by land

*based on estimates in on the Somerset Moors and Levels, S. W. England

**excluding any environmental payments on grassland, but including CAP area payments on arable.

***direct labour and machinery operating costs only.

****including labour costs, machinery operating and depreciation, and housing/building costs for stock.

use type and by the particular financial measure which is used to assess income loss, whether gross margin or net margin. For the assumption made, compensatory payments of between £200 and £300/ha. may be needed, conditional upon positive environmental enhancement. These are consistent with the range of payments currently paid under the UK's existing agri-environment framework incorporating ESA and Stewardship arrangements (see subsequent section). At present land managers in ESA wetland areas are paid between £80 and £430 according to the level of compliance required.

Of course, farm subsidies need to be stripped out of the financial analysis to determine the value added from an overall economy perspective. Defra provide guidance on the use of economic adjustment factors (MAFF, 1999). The switch to heavily subsidised livestock systems may reduce the

economic attractiveness of switching to extensive livestock systems. However, Defra are willing to accept environmental payments to farmers as an indicator of society willingness to pay for, and hence the value of, environmental enhancement (MAFF, 1999; Penning-Rowsell, 2003).

Administrative Options for Flood Storage

There are a number of alternative forms of management and administration for washland creation and operation. These include land purchase, easements on flooding, management agreements supported by annual payments and leaseback partnership arrangements (Morris et al, 2002).

Under the land purchase arrangement the land asset is voluntarily sold by owners at prevailing market prices to a responsible organisation which manages it in accordance with programme objectives. The organisation involved may operate the site directly or may manage it indirectly on short term or seasonal tenancy agreements with farmers, with preference to previous owners/tenants. There is a growing experience of this type of purchase and of subsequent operation and maintenance by voluntary and statutory conservation organisations, often working in partnership.

The land purchase option, in that it involves up-front financing and asset and management transfer for the purpose intended, has a relatively high chance of success. Further, the transfer of responsibility for ownership and operation to a responsible authority, has the potential to deliver effectively against the programme objectives, especially floodwater management and environmental objectives. Land purchase also lends itself to capital funding, including eligibility for capital grants (as in the case of flood defence capital projects). The challenge of negotiating annual agreements, and variations in these that reflect design or actual water regimes, is removed.

However, there is a risk that local and community ties with the land are reduced once ownership becomes institutionalised, and there may be associated problems of attracting and negotiating tenants. There will also be administrative challenges lining up volunteers for land sales, especially in areas characterised by fragmentation of holdings. It is easier if large blocks of land or whole farms can be purchased from a few individual owners. This may be feasible in some locations and farmers may be inclined to sell if land can be acquired elsewhere in the vicinity. Some farmers will see land sale as an opportunity to exit the industry, relocate or refocus. A land bank could be used for this purpose, whereby the sponsoring organisation buys up land locally to achieve land or whole farm swaps. This approach has been used in Denmark and the Netherlands and to a limited extent in Britain. Compulsory purchase in the public interest could also be considered to ensure the integrity of flood storage schemes. However this is unlikely to prove popular even though it may be the only option to deliver a large scale, comprehensive scheme. Land purchase, whether voluntary or compulsory, is also potentially unfair on those who would otherwise wish to continue farming as before.

The purchase of flood storage easement takes the form of an up-front payment, expressed as a % of prevailing market prices. This easement reflects the loss of asset value, and related income loss into perpetuity, associated with specified increased flood risk. The arrangement is subject to an easement

agreement, which specifies conditions applying in each case. Owners retain rights which are not the subject of the easement and its effects. This model has been used over the last 20 years by the Environment Agency in flood alleviation schemes. Payments have ranged between 40% and 80% of market land values reflecting easement against a design flood event.

Easements are designed to accommodate changes in the risk of flooding borne by existing owners and occupier. For the most part they apply to infrequent, major flood events which potentially cause occasional damage rather than significant changes in land use. Owners, and occupiers through reduced rents, receive compensation for absorbing the risk of increased flooding. Occupiers can insure themselves against known risks if they wish.

Easements are attractive to flood defence organisations because they involve a one-off negotiated settlement, the cost of which can be charged to a capital scheme and which, in the case of flood defence, is potentially grant-aided from Government. In some cases, easements which serve the public interest can be compulsorily acquired by Government bodies.

Easements could potentially deliver the flood defence objectives of washland creation, but are less effective for delivering environmental enhancement or livelihood objectives. They will produce a one-off injection into the farming community, but will substantially reduce remaining asset values. Although, initially they could be administratively easy to establish, there are risks that the terms of the easement may restrict operational flexibility and be a source of contention if water regimes differ from those covered in the agreement. Given the proposed frequency of flooding, it is likely that easements would approach the full market value of land, in which case outright purchase might be preferred.

Arrangements involving annual payments allow existing tenure arrangements to continue. Farmers sign a management agreement for a specified minimum period with a responsible organisation which specifies land management in accordance with programme objectives. The contract may be for a given flood storage facility, possibly specified by timing, duration and depth. Although these will include environmental protection measures, they may or may not require actions to enhance the environmental quality of the site itself. Farmers receive annual payments in return for services rendered.

Management agreements are commonly practised under the European Unions Rural Development Regulation agri-environment scheme package. Within the UK this includes Environmentally Sensitive Areas (ESAs) (Defra, 2002a) and Countryside Stewardship (Defra, 2000b), amongst others. ESAs are areas designated primarily for nature conservation interest. Farmers within these areas are free to opt-in in return for annual payments based on restricted management practices such as limiting agro-chemical use, stocking rates and periods. The Countryside Stewardship scheme on the other hand is discretionary, is available across the country (different schemes operate within the different UK regions), and focuses on targeted landscapes. Each scheme has a number of options from which the farmer can choose to incorporate within a management plan. Farmers are required to draw up the management plan themselves to apply for the funding. Applications are undertaken annually, and not all applicants will necessarily receive funding for their plan.

Stewardship, as a result of option identification, places more emphasis on environmental outputs than ESA agreements which tend to focus on compliance.

Annual payments in return for management agreements are common place and well understood. They have been widely adopted directly by farmers, and by institutional land owners who use them as a basis for delivering their own environmental objectives, often through tenanted farmers. They are also a key component of farm incomes and underpin much subletting of land, providing income to owners, and to a degree, low rents to tenants.

Given the experience to date, a Washland ESA or Stewardship scheme would be relatively easy to set up and administer, and could be an extension of existing arrangements. ESA terms could be drawn up for specific hydraulic units, or sub units to reflect existing and future typical land use, proposed water regimes (flood risk characteristics), environmental enhancements and related compliance costs. Alternatively, Washland Stewardship agreements could be drawn up with land managers to reflect specific site and farm circumstances. Payments would reflect a defined flood facility, environmental enhancement and compliance prescription.

Consequently, annual payments have the potential to meet the multiple objectives of flood plain management. They offer some flexibility to the responsible management organisation to direct change in accordance with changing circumstances and priorities. They are compatible with the principles of the new Rural Development Regulation which seeks to strengthen the social and economic viability of rural communities through support to agri-environmental and diversification initiatives.

However, there is debate regarding the efficiency of annual payments from a public purse viewpoint. They are expensive, may pay farmers for doing what they would do anyway, and can create a dependency and, from this, a future vulnerability. Further, annual payments may need to exceed 'compensation' levels in order to persuade farmers into adoption. Simultaneously, their magnitude (like land prices) may reflect the extent of subsidy to the farming sector, rather than any economic opportunity cost or added value. At a practical level, annual payments are at risk of policy change and funding availability, especially as they rely on revenue rather than capital funding. This concern applies to farmers and responsible organisations alike. Farmers, perceiving a return to a previous and possibly irreversible wetland condition, will seek security of payments over the medium to long term, probably 20 years. Implementing organisations may also feel vulnerable in their dependency on Government funding.

Their greatest drawback is that they place a high ongoing burden and dependency on continued revenue funding. To be attractive to farmers, they need to be secure for the longer term.

Finally, the lease-back/partnership initiative transfers land entitlement in the form of a lease from farmers to a newly created project organisation for a specified period (20 to 30 years). As partners, farmers operate the land in accordance with programme objectives for which they receive annual payments. At the end of the lease term, the arrangement can be extended or terminated. In the latter case, land returns to partnership farmers. A joint

management committee with representation by the major partners would be formed to manage the initiative.

The transfer of the management of land assets to a responsible partnership organisation of which the asset owners are part has the advantage of focusing on the programme objectives, vesting management responsibility in a programme management unit, and directly engaging farmers in the process of delivery. The 'partnership' approach is consistent with the idea of sustainable and wise use, and is likely to meet with approval from potential sponsors. It is likely to be more administratively and legally complex to establish, and there may be resistance from land owners to engage until the benefits are clear, especially as they, as contributors of the land assets, carry the greatest risk. They would, however, enjoy management participation and security of agreement. It is possible that a partnership approach would lend itself to a private-public partnership/private finance initiative. This leaseback option could suit situations where there is a clear community of interest.

In summary, the suitability of these options varies according to the purposes to be achieved, the need to provide long term robust solutions, and, linked to these, the preferred link between the farming community and the management of the land.

All of the aforementioned approaches are potentially feasible. Land purchase, annual payments and leaseback have their particular advantages, disadvantages and risks, and suit the interest of different groups. Easements may be appropriate to accommodate modest increases in flood risk, but probably not for regular deep flooding and where there is a wish to achieve environment enhancement.

The diversity of circumstance and practice within floodplain areas suggests that a diversity of approaches to washland administrative arrangements will be needed. A mosaic of land tenure arrangements may be acceptable provided this can deliver the scale, integration and reliability of service required.

Further, institutional and administrative arrangements for flood storage and washland creation should reflect the land management and funding mechanisms. Given the multiple objectives to be served, a Washland Programme organisation with membership drawn from key stakeholders, would provide strategic direction and management, delegating responsibility for administration of the programme and its constituent projects to member organisations as appropriate. In the UK, the flood storage facility could be managed by the Environment Agency in collaboration with Defra and the Internal Drainage Boards. Statutory and voluntary conservation organisations could variously manage operations at project area level. If it was decided to progress washland creation through an annual payment regime, it would make sense to administer this through existing mechanisms such as those operated by Defra or English Nature.

Finally, in addition to the possibility of land purchase, easement costs and/or annual payment, a meaningful estimate of costs needs to include design, supervision, engineering works, and operation and maintenance costs. These costs, reflecting the capital and operating costs of 'engineering' washland projects, are very site specific and will vary according to flood

characteristics and impacts. However, it is likely they will replace some costs currently committed to conventional flood defence.

Conclusion

It is considered feasible to create facilities in the flood plain of a river catchment which will store flood water and create washland, and which will potentially meet all or some of the multiple objectives of flood and water resources management, environmental enhancement, and farming livelihoods. However, there is both synergy and conflict of interest in washlands amongst flood storage, environment and farming objectives. Different sites are likely to have different priorities and management systems. Accordingly, prescriptions for flood facilities, environmental and farming management will require local definition.

Further, the storage of winter floodwater and washland creation on farmland will result in income losses to farmers, and would mean a switch from arable to grass, and from improved grassland to extensive systems. The extent of loss of net income (revenues less costs) associated with a switch in cropping and extensification will depend on whether farmers can achieve savings in costs to offset reductions in revenues.

Set against this, is the scope to design a washland flood storage package, involving land purchase, easement, annual payments, or partnership/leaseback. Given the diversity of circumstance and practice across the UK, a range of approaches to washland tenure arrangements is suggested, provided this can deliver the scale, integration and reliability of service required. Payments should reflect the different levels of risk. Where the owner maintains occupation, payments should also reflect the timing, duration and depth of flooding.

At present, however, there appears to be a number of barriers to the adoption of Washland options by farmers. These include:

- High degree of uncertainty concerning farming futures and related policy framework, and linked to this a lack of trust by land managers in some of the organisations involved in the management of change.
- Lack of evidence that farming on washlands is feasible and practical, and limited demonstration to date of the viability of 'new' washland farming practices.
- A wish to continue farming commercially, a perception that the washland option is not compatible with this and a reluctance to return to wetland after a lifetime of drainage improvement for agriculture.
- The perceived inadequacy or unpredictability of existing agri-environment payments and insufficient targeting for flood storage and washland options.

Nevertheless, at current levels of government support, there appears to be an economic advantage in moving to extensive washland farming systems. Given the potential to achieve further social economic and environmental benefit, it would appear in the public interest to redirect funding into flood storage and washland creation as part of an integrated and sustainable

approach to flood management.

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CONFERENCE PAPER

BUILDING A FARM BASED FOOD BUSINESS¹*James Parrish*

This paper describes the evolution and business trajectory of Parripak Foods. Germinating from an idea gleaned from a study tour, Parripak's first steps involved peeling out-graded onions, the company now employs over 200 workers. In this paper I will describe the origins and key business and family decisions to describe the growth trajectory of Parripak Foods to its current position.

Key words: farm diversification, business growth, marketing, vegetables.

Introduction to Parripak Foods Ltd

Parripak Foods Ltd grew from a farm-diversification enterprise. The farm has been in the family since 1927, when my grandfather took it on and built up a dairy herd and milk round. The farm's 750 acres is set in the green sand belt of Bedfordshire, it has 14 different soil types. Most of the current emphasis is producing vegetables for supermarkets. The main crops grown are onions, potatoes, shallots, red onions, supa-sweet onions and cereals. The farm has its own grading and packing lines.

My brother, Nick, started the processing business. The farm was generating second grade and skinning onions, for which we could not identify a market. On an onion tour to Hungary, Nick saw an unused onion peeler in a State owned factory and he had the idea of buying the machine to process the out-grade onions. Parripak Produce was the trading name for this new business, which started within the existing farm partnership. The business was set up in part of one of the farm onion stores, a 3,000 ft fairly basic building. Initially, the main customers were vegetable freezing companies. This was low margin work and the business struggled to be profitable.

The new enterprise needed new markets and this came in the form of local companies who were setting up in chilled convenience foods. The first customers were an Indian snack company and a chilled pizza manufacturer. Soon a wider range of vegetables was needed – carrots, potatoes and onions to go into Indian snack products; peppers, spring onions and mushrooms to go on pizzas. Our customers needed fresh ingredients and daily deliveries, they needed product diced and sliced. Demands on production and service provided grew.

Business development

Diversification is constantly stressed as one way to improve farm incomes, as explained by the Ansoff (product/market) matrix (Table 1). This matrix considers the market options available in relation to the products/services provided. In both these areas, one can either stay as you are or opt to explore new options. Diversification into both new products and new markets at the same time, is the most risky strategy. At college we were always advised

1. This paper was presented at the Farm Management Conference, November 19th and 20th, Bedford, 2003.

against this route, nevertheless this is the direction our family farming business chose. Table 2 outlines the key business decisions.

Table 1. The Anzoff (Products/Markets) Matrix.

MARKETS	PRODUCTS	
	EXISTING	NEW
EXISTING	Market penetration	Product/service development
NEW	Market extension development	Diversification

Source. Christopher, M and McDonald, M (1995).

Table 2. Key business decisions and business trajectory

Dates	Business Decision
1987	Started peeling out-grade onions for vegetable freezing companies.
1988	New markets – chilled convenience food manufacturers.
1989	New products – carrots, potatoes, mushrooms, peppers.
1991	Converted another farm building into a new venture processing garlic products.
1992	Planning permission was sought for a new factory (turnover at the time was £1mn).
1993 (Feb)	A European grant was approved for the new factory.
1993 (Feb)	Planning was approved for a new 23,000sqft factory designed to produce 80-100t per week.
1993 (April)	The processing side (Parripak Produce) was separated from the farm and set up as a limited company – Parripak Foods Ltd.
1993 (October)	The new factory was completed.
1995	The factory was extended to 30,000 sq ft - 35 different types of Vegetable used.
1999	The factory was extended to 42,000sq ft giving more warehousing and workshop area (turnover £9mn).
2000	New Garlic Processing unit completed.
2002	Major New project to improve throughputs and efficiency with the help of a European Grant.
2003	Had a record week and produced over 550t in a week.

A key explanation of the success of the venture was the people involved, their motivations and what they brought to the business. My father, Grahame Parrish has farmed the family farm for over 35 years. He focused on growing, storing and packing field scale vegetables. Importantly, he has always supported Nick and myself and has always been receptive to new ideas and ways of doing things. His financial guarantee to the bank in Parripak's first year as a trading enterprise separate from the farm business proved crucial.

We invited a neighbouring farmer, Robin Allingham, to become involved in 1991, at a time when we felt we needed a new pair of eyes to assess the strategic development and direction of the business. Robin subsequently became Chairman of Parripak Foods Ltd. As an “external” board member he provided a different perspective that proved particularly valuable in deciding between difficult options. Robin also brought crucial skills to the business - including his knowledge about planning permission, general business knowledge, and his careful attention to detail.

Brother Nick was the founder of the business. On joining the farm partnership in 1984, Nick was asked to focus particularly on the cereal side of the farm. However Nick was looking to broaden his responsibilities and is now joint Managing Director with responsibilities mainly concentrated on Operations and Production. At college he had studied Agricultural Engineering, and this was invaluable in developing the production side of the business. His particular strength is his ability to mechanise production and in designing production facilities. Nick has attended two business development courses at the Cranfield School of Management.

I joined the business in 1992 after graduating in Agriculture and Marketing. During my sandwich year I worked for Waitrose in their Fruit and Vegetable Buying office. This was a real eye-opener, revealing the potential markets in food retailing. I became joint Managing Director in Parripak Ltd with particular responsibility for Purchasing and Sales. In 1997 I studied part-time for a Masters in Business Administration at the Cranfield School of Management.

The Markets

The Company's main market is chilled ready meal manufacturers. Between 1995-1999 this market grew by over 30% and is now valued at over £700mn (Key Note, 2002). The trends that have caused this include:

- Lifestyle changes – more women in the workforce , less time, more leisure, greater disposable income
- Microwave oven
- Foreign travel
- Supermarket Own label
- Consumers willing to experiment
- Growth of vegetarianism
- Celebrity chefs have increased the interest in food

Consumers are getting ever more used to convenience foods and as time has gone by, we have always been amazed firstly that you could sell roast potatoes and now shredded cabbage and even mash potato. The supermarkets are continuously locked in fierce price wars. The biggest change came when Wal-Mart bought Asda and they took this supermarket to become the second largest in the country in terms of sales.

Innovation

Many of our ideas started in the family kitchen, for example, sliced

mushrooms. These were needed for pizzas. The mushrooms need to be sliced into regular T-cuts and the first trial orders were done using hand held kitchen egg slicers. A new pizza was launched and we were soon receiving orders for up to 1,200kg of sliced mushrooms per day. The egg slicers could not cope and a machine had to be developed fast. Nick investigated how frozen manufacturers sliced mushrooms and adapted a machine that would process mushrooms for the chilled market. At the time, the adapted machine was a major capital purchase for the business, but it could cope with 600kg of product an hour.

The chilled prepared food industry is around 17 years old, so is still fairly young. This means that there are still substantial opportunities for innovation and improvement in efficiency. In manufacturing terms we can still make quite major improvements whereas compared to, say, the car industry where markets are fairly mature, it is difficult for manufacturers to differentiate their products from their competitors.

We spend a lot of time on innovation in the business. The key is to find the new lines of the future and to ensure that the company focuses on higher margin lines. Within the U.K industry product development is fast moving: supermarket development teams are continually looking for the next “big winner”. Some of the biggest successes have been products like the prawn cocktail sandwich, bacon and mushroom pizza, onion bajhis, carrot and coriander soup and potato wedges. As the market matures it is more difficult to keep coming up with new ideas and a key measure of success is how innovative you can be.

Phases of business growth and key decisions.

Figure 1 shows the sales growth of the business sales from 1987 to date. The business can be characterised as going through 4 main developmental stages: the entrepreneurial phase, the growth phase, the control phase, and a second growth phase. Such phases are common to businesses expanding with new products in new markets. The transition between phases is often a major turning point or crisis point to the business.

Key features that distinguish phases include:

The Entrepreneurial phase:

- a lot of new ideas
- business very immature with a basic structure
- business very flexible and control very hands on
- entrepreneurs have to cover many different areas of the business

The growth phase

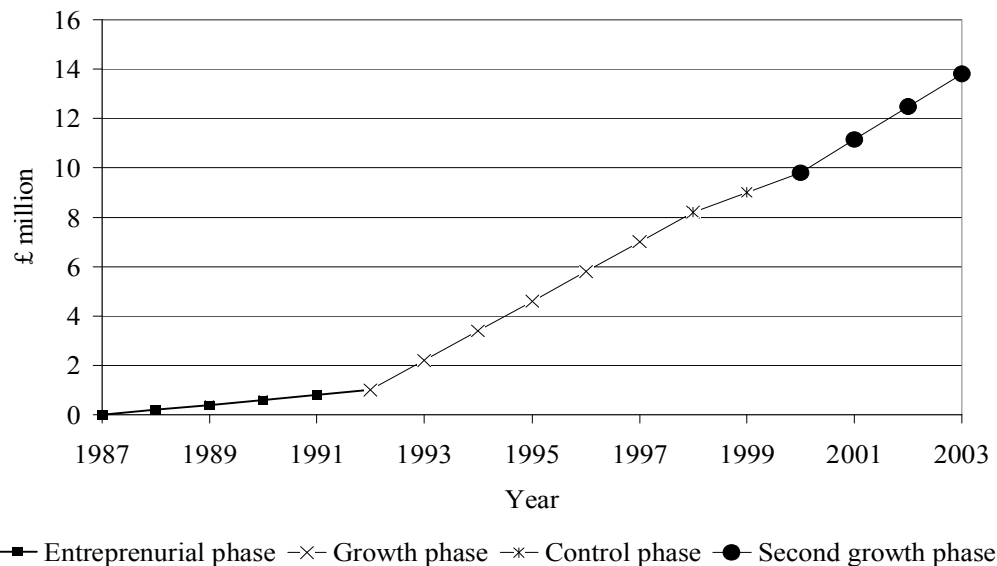
- energy goes to increasing production and utilising capacity
- business becoming recognised as a serious food processor
- has to become more competitive and innovative.

The control phase:

- business has to concentrate on efficiency

start to measure and control processes more effectively
 more focus on product margin
 more emphasis on training and development of people.

Figure 1. Growth in Sales of Parripak Foods Ltd. (1987-2003).



We experienced two key crisis points in the growth of Parripak Foods:

The crisis point of survival – this represented the first crossroads for the business where it either had to expand and move into a new factory or it would be forced to close.

The second crisis point followed after 5 years of growth when the business needed to take stock to ensure it was efficient and focusing in the right areas as well as in control of its destiny.

One stumbling block for anyone in this country trying to do something new is the entrenched attitudes to risk and failure. In the US bankruptcy is seen as unlucky in the UK it is typically seen as failure. In the farming world, I think that this is even more pronounced with close knit communities that can often look on with dismay at those trying to do something different. Remember the definition of insanity is doing the same things and expecting different results.

The “Big Step”

This coincided with the first survival crisis point and was the most risky time for the company. In the late 1980's, the old factory was looking tired and did not meet customer expectations in terms of fabrication. Moreover, it did not have the flows and controls necessary to ensure the highest standards of efficiency and food safety. In 1992, the business had either to seek a new site

to expand or wind-up. We put in a planning application to build a new factory on a green field site, 200 yards from the main farm buildings. It took 18 months to get planning permission. The country was in recession and our local planning committee was putting up barriers to stop the new factory going ahead. At the same time we were applying for a European Grant to cover 30% of all purchases of new capital equipment and buildings.

Our first main meeting with the Bank to discuss our business plan turned out to be 'Black Wednesday' – 16th September 1992. Robin, Nick and myself sat in the bank's reception with a television screen above our head. As we sat there, sterling went into free fall, the Bank of England intervened and interest rates went up to 15%, which was the second rise that day. We wondered whether it was time to go home. The bank manager gave us some vital advice and set out a risk score that the bank used in analysing risk. I remember coming back from the meeting thinking that the chances of us going ahead were very slim and the fact that interest rates had gone up so high had added more risk and complication to the project ever getting off the ground.

For the project to go ahead we needed the European Grant, Planning Permission and a loan from the Rural Development Commission. The timing was also crucial as our customers would not wait any longer and if we didn't get through this grant application it would put us back another six months. Luckily we managed to get all three and work began on the new factory in May 1993.

In October 1993 the plant was ready to run. The first six months were incredibly difficult. It took a long time to adjust to the new factory, initially we struggled to get the same production out of a space, which was 8 times larger, and it was difficult to get new customers on board. Three months into the start of the new factory, we had one of our customers go into receivership and at that time I seriously thought that our survival was unlikely. We had been to food exhibitions, printed brochures and had a lot of interest, but most of the customers had already placed business for the year. We were going to have to wait until the spring, when a difficult time on raw material quality, enabled us to sell to new customers.

Competition

Over the years we have had fierce competition. Now we have 8 main competitors, but we have seen over 25 companies either stop or go out of business. The failure rate is quite high. We continually benchmark against our competitors to ensure that we are in the front runners.

Working capital

The business is similar to the farm in needing a high level of expenditure on plant and machinery, but Parripak needs more working capital, particularly to bridge the gap between receiving payment and paying our suppliers and wage bill. The business has needed to generate reasonable profits in order to keep investing in improved processes and efficiency. Without this it would soon lag behind and lose its competitiveness.

Contract prices

Ready meals are typically set at fixed prices through the year and only varying when on promotion. Our customers generally require fixed prices on vegetables on an annual basis in order to control their costs. In the last 12 years we have paid from £40/t to £420/t for onions, which highlights the need to have fixed price contracts with suppliers so as to meet our customer needs. In one year, the El Nino weather system caused onion crop failures in the Southern Hemisphere, which increased market prices and therefore our costs. There is a trend for our customers to opt for 12 month fixed price contracts, and it can be difficult to match the risk and the reward of such long term contracts. Global warming and El Nino weather systems are increasing the volatility of vegetable prices, so if we get the contract price wrong it can be extremely costly to the business.

The Future

In the food business, like farming, we can easily get caught up in the trap of increased volume needing increased efficiency which reduces margins. The key is to remain ahead of the competition by developing truly innovative products. For this we need to ensure we have the right people and offer them effective training, as it is people who drive the business forward and who keep the business creative.

Conclusion

What then are the key lessons from this case study. Key ingredients for successful farm diversification and adding value include openness to change and new ideas (stimulated in this case by travel), aptitude and interest in all aspects of the chosen diversification project. A key decision was to involve an external party in a “family” business, because this complemented the existing skills within the team. Market research is key – in our experience it all comes back to having the right products in the right place at the right time. It is also important to choose an enterprise with capacity for growth, innovation and improvement. Applying for grants can be time consuming, but it was crucial both in getting the diversification started and later making the step to becoming a business that stands on its own. We consider ourselves willing to learn and a high tolerance level to hassle is certainly a benefit. It is important never to relax, to always be ready to respond to challenges and be prepared to change things if necessary. Picking people is an especially useful skill to have, as is having a good bank manager! Finally, sheer hard work, blood, sweat and toil, coupled with that intangible of all assets, a high quotient of good luck.

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Biographical Notes

James Parrish graduated with a BSc degree in Agriculture and Marketing. He worked for a year in Waitrose, before returning to the farm started by his father in 1937. He is currently joint Managing Director of Parripak Foods Ltd, Lodge Farm, Chicksands, Shefford, Beds, SG17 5QB.

CONFERENCE PAPER

**MANAGING CHANGE THROUGH BENCHMARKING
BEST PRACTICE***Trevor Atkinson*

“4 Thought” is the benchmarking system published for internal use by Sentry Farms. The data presented in 4 Thought is based on data gathered from real farms, thereby allowing the processes that underpin financial performance to be identified and permitting on-farm decision makers to contact managers of best performing farms to discuss the appropriateness of following their successful blueprint. As well as improving performance, this means that each farm-manager does not have to individually solve common problems. This paper gives some examples of how Sentry Farms uses benchmarking to identify cost savings and thereby keep one step ahead of the competition.

Key words: benchmarking, competition, decision making process, farming.

Introduction

Sentry Farms is a private limited company operating in the UK. It works with a large range of landowners – each with their own priorities and objectives - by way of numerous operational leases. The company is currently producing over 100,000 tonnes of produce in the form of cereals, oilseeds, pulses, root crops and milk. Farming in the UK is traditionally a very visible business which in times of good profits has allowed image and emotion to be the driver behind many decision making processes. This has been good news for the peripheral supply industries as total costs, left uncontrolled, frequently rose towards total revenues. With current world market prices making the high prices of the late 1980s and 1990s very distant memories, cost structures and production systems have changed and are continuing to change across the entire agricultural industry so that some of its component businesses can survive.

Working with commercial rental equivalents, Sentry Farms has also had to change, and change quickly, in order to survive. A part of the process of managing the change has been the direction and support Sentry has provided to its 20 managers and trainees; the people in the decision making process at the farm level. One aspect of the direction and support has been to encourage best practice in its farming businesses through use of our internal-published benchmarking system, known as “4 Thought”. It is now in its 10th year and, as far as I am aware, it is unique in the UK in taking benchmarking beyond the usual headline financial parameters, to provide support for the short-term, day-to-day decision makers.

Benchmarking

At Sentry, we have been benchmarking our farms from its early days in the 1970s. Every year new aspects of the business come under the microscope

1. This paper was first presented at the 14th International Farm Management Congress, Perth, Australia, August 11 to 15.

with the ultimate aim of identifying improvements to efficiency and increasing the bottom line - profit. The parameters we are working to have changed dramatically throughout this period, and they will continue to do so. We believe that looking at our businesses in such detail gives us a competitive advantage in the market place.

We have the advantage of a significant sample size, 20+ units covering approximately 15,000 hectares, and a wide geographical spread, from West Lothian to Suffolk to Dorset, from which to collect our information. Our internal benchmark data enables our managers to learn from the trials and tribulations of other units, thereby avoiding making similar mistakes themselves. It is comforting to know that all the benchmark data come from actual businesses, so managers can quickly contact and visit the outstanding farms to discuss the underlying reasons for the good performance.

Our experience shows that most of our farms excel in one or other aspect of the range of efficiency measures we calculate. However, “4 Thought” is definitely not a league table to establish which of our managers has the best farm. Our aim in publishing a wide range of benchmarking data is to influence the decision-making processes that steer and fine-tune our businesses.

In my early days as a Sentry Manager, I could never understand why the farms that produced higher yields didn't make higher profits given similar rental equivalents. I suspected that the law which states that 'cost will always rise to match income' had something to do with it. However, due to the characters involved and the very visible nature of the industry, it has been a challenge to change attitudes. Telling farmers or farm managers to change will always receive a negative reaction as it comes with the implication that they are 'not good at what they do' or that they have been doing 'something wrong'. I believe the answer is to work with our managers, in their environment and their language, to help them discover new ideas.

Farming with subsidies has provided a comfort zone in which 'well tried and tested' procedures have survived. For example, not purchasing a new combine harvester every three years was seen as very second division farming in some farming circles and we all aspired to be in the premiership - visibly if not financially. We, the farming industry, were totally hooked on non-financial parameters albeit, perhaps, because we thought we were efficient and anyway our income allowed us to afford them.

“4 Thought”: background

We wanted to challenge these notions. We wanted to encourage our managers to look at how other businesses were performing and to think how their business compared. We needed to cover a wide range of performance parameters to prove that all farms were efficient in some areas but poor in others, to show that all farms could show some improvements and therefore benefit financially. We believed it was important to influence the thought process before decisions were made. To do this we needed up-to-date data, not data 18 months out-of-date. In addition to all these requirements, it was imperative for benchmarking to be viewed positively and to be used as a management tool.

To achieve this we designed our benchmarking system, which by this

stage had been given the name “4 Thought” to provide an identity and a more user friendly name, to highlight the following objectives:

- Expose people to new ideas
If a new approach is working well on one farm we needed to communicate it quickly to the other farms, so as to avoid the need for each manager to re-invent strategies to overcome a common problem.
- Serve as a catalyst for learning
The more aspects you highlight the more questions are asked. It encourages us all to learn more about our business, and what they are, and are not, capable of.
- Overcome natural disbelief that a business can perform to a higher level
It is relatively easy to be a big fish in a little pool. Benchmarking increases the size of the pool.
- Create an external business view
Statistical analysis of a business is a great tool for external business advice. It provides a factual starting point for any person performing a review of a business.
- Lower the costs of production
The aim is to grow produce at a cheaper unit cost, through either increasing output volumes at the same expenditure, or by maintaining output at a lower level of expenditure.

Sentry Benchmarking

With many different users, we had to make “4 Thought” reconcilable, so we chose as our common denominator ‘profit (pre-rent and finance)’. Using this as the initial starting point, we designed the data collection to allow users to “drill down” to the individual component parts that combine to form the profit figure, thus identifying which parts of the business were contributing directly to the better (or poorer) performance. The principle components of “profit” divided into: ‘Direct Costs’, ‘Labour Costs’, ‘Machinery Costs’, ‘General Costs’, ‘Farming Income’, and ‘Other Income’. These could then be broken down further as follows:

- Direct Costs
Seed/ nitrogen/ phosphorous and potassium/ herbicides/ fungicides/ trace elements/ feed/ vet and med/ etc.
Rates of application/feed rates/timing/response.
- Labour Costs
Management/ office/ full-time/ part-time/ seasonal/ other
Overtime hours/ package benefits.
- Machinery Costs

Repairs/ depreciation/ hire/ fuel/ insurance/ HP per ha/ hrs per ha/ fuel per ha/ machine downtime/ machine age/ machine output.

- Rent and Finance
Land rents / property rents/ hire purchase/ lease purchase/ loans/ overdraft.
Bank charges/ interest rates.
- Farming Income
Milk/ beef/ lamb/ wheat/ barley/ oilseed rape/ pulses/ subsidies etc.
Crop rotation/ yields/ soil type/ product value/ market outlet.
- Other Income
Property income/ horses/ consultancy/ woodland/ other activities.

Many of these parameters overlap and so cannot be looked at in isolation. One farm unit may have more productive land which generates high yields, but it may also have higher fixed cost, giving a net result of a lower profit than another lower yielding but lower fixed cost farm. Taking a realistic view of potential yields is quite often necessary to establish what cost structure the land can support. Through the accumulation of real data over time, it is possible to establish reliable trends and so eliminate over optimistic forecasts based on the occasional high yielding year.

Sentry Benchmarking – practical examples of business applications

One of the common threads deducted from the data collected from the 2003 harvest was that our more profitable farms tended to have lower direct costs, machinery costs, labour costs and general costs per hectare. Several examples are set-out below showing how the use of “4 Thought” has reduced our costs.

Wheat production

With current wheat prices at a lifetime low, and ever increasing pressure from our global competitors, Sentry keeps striving to lower production costs. The cost of producing a tonne of wheat in 1997 and 1998 is shown in Figure 1. The data includes all costs other than rent and finance. The average yield in this sample was 7.36 t/ha and the average production costs was £60 /t.

It is possible to split these costs into bottom and top 25% and pass comment accordingly – and we can have endless discussions about the merits of various techniques and approaches. The problem with doing this is that one may encourage the land with lower yield potential to chase land with more productive capacity, resulting in increased costs when there is little realistic chance of receiving the necessary yield response. In the UK we fear cheaply produced wheat imported from the vast expanses of Central Europe (CE in Figure 1). At an average yield of 5.3 t/ha their production costs are £10 /t less than ours. If the market price is £55 /t our higher yields are irrelevant – our competitors make a profit, we don't.

Figure 1. Costs of production for wheat (Cost based on variable and operational costs per tonne).

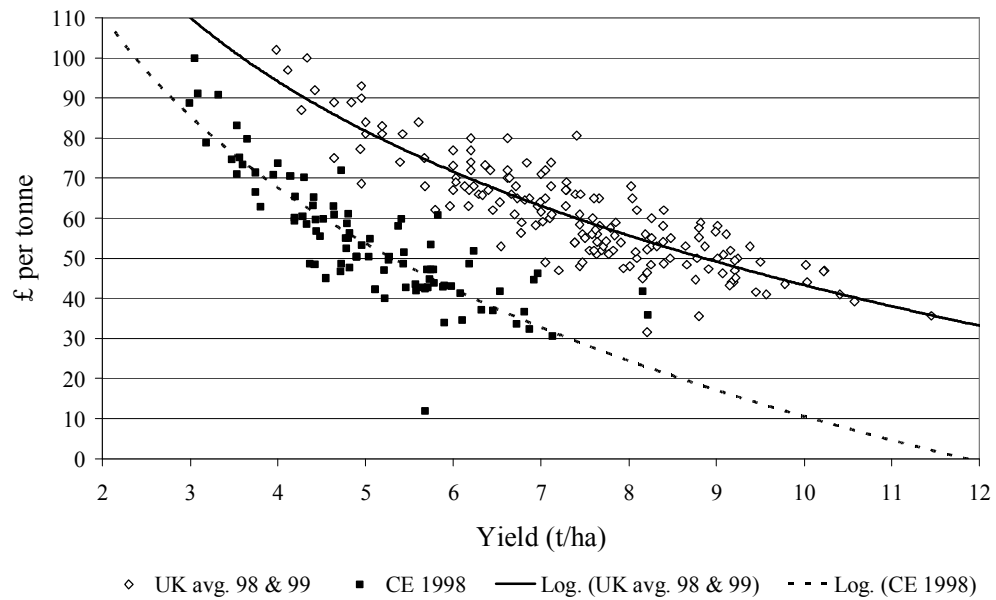
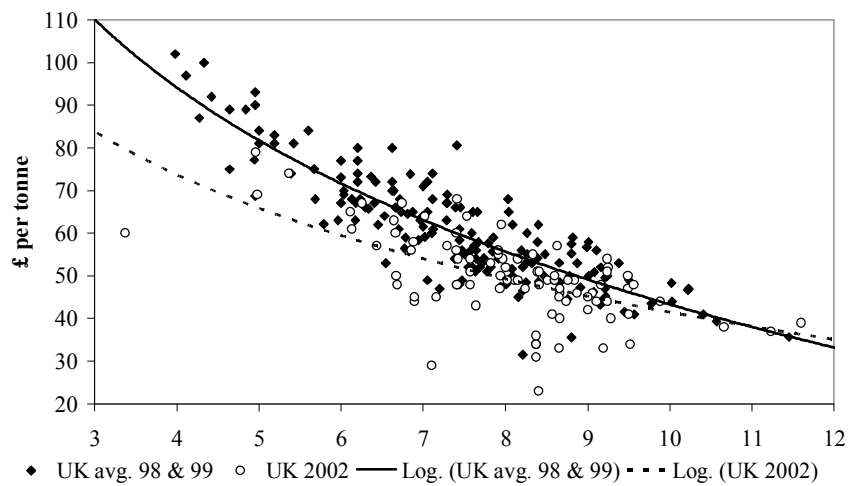


Figure 2. Cost of production for wheat (based on variable and operational costs per tonne).



That higher yield lowers unit costs of production will always act as a carrot for producers to aim for higher yield. However, we have found that taking a realistic view of the productive potential of our land is key, it may sometimes be hard to remain objective and rational, but it is important to do so. It is a key fact that we have to recognise in our forward plans.

The cost of producing a tonne of wheat in 1998/9 was £60 /t pre rent and finance, at a yield level of 7.36 t/ha. The same figure for the wheat we produced in 2002 was £50 /t at a yield level of 8.1 t/ha (Figure 2). This has been achieved not so much by the high yielding fields producing more, but by reducing the number of poor yielding fields and improving the rotation. Additionally we have become more extensive in our operational costs and reduced the number of cultivations taken to establish, grow and harvest the crop.

Fertiliser

Individual farmers and farm managers adopt various approaches in formulating their fertiliser requirements, ranging from personal experience, to soil analysis and their expectation of the potential yield response, to name just a few. It was noted that the total application of potash and phosphate across Sentry Farms was in excess of that being taken off as crop. This prompted the introduction of a 'balance sheet' approach where applications are matched to crop off-take. A simple calculation involving the percentage of potash and phosphate taken off the field via crop yield forms the basis for this balance sheet. As these fertilizer applications must be made before yields are known, an expected yield has to be used. Any over- or under-application is carried forward and adjusted for in the next crop using a field specific balance sheet. Calculating this data across the whole farm has given a quick measure of key aspects of the efficiency with which we use fertilisers and has helped to explain some of the observed variances between farms.

For example, one of our farms regularly applied 250 kg of a 0:25:25 compound fertiliser on its wheat acreage. This is equivalent to the off-take of phosphate and potash from a yield of 7.9 t/ha, but actual yields were only 7.1 t/ha. By using 'straights' rather than 'compounds', and matching rates to yields, expenditure on phosphate and potash fertiliser has fallen by £3 /ha.

Crop Establishment

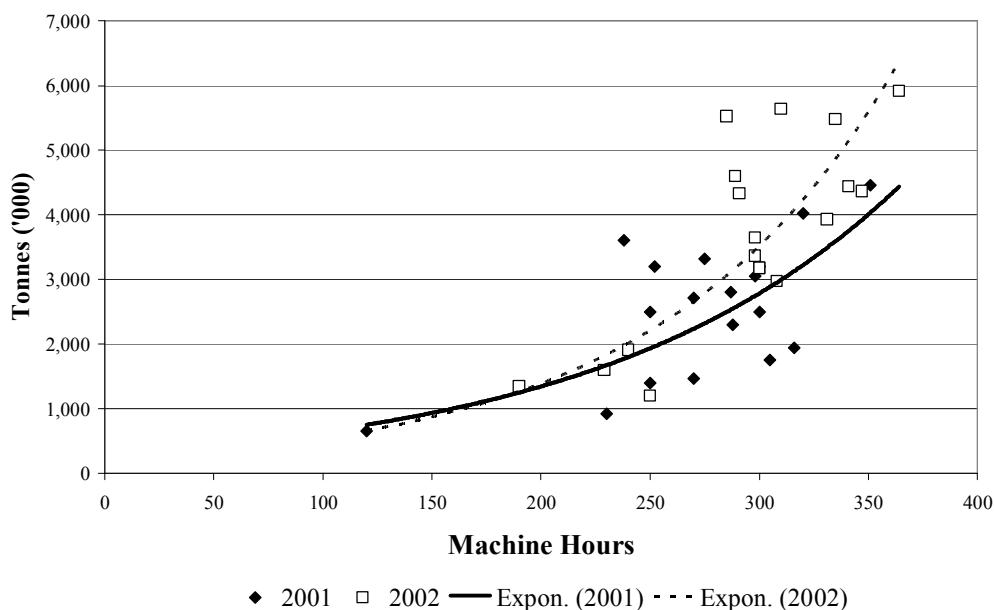
Cereal seedbeds are produced to many different specifications and standards, depending on a range of factors, including the season, the equipment available, soil type and the manager's perception of what type of seed bed is needed. There are many combinations of seedbed preparations, from the one-pass combined operation to the multi-pass system, using a range of soil tillage tools. Measuring the number of machine hours used to establish, cultivate, grow and harvest a crop provides an important insight into how 'intensive' or 'extensive' our field operations are. The current range is from 2.5 to 6 machine hr/ha. At an average cost of £25 /hr, this demonstrates the significant scope for increasing overall efficiency.

For example, one farm was run very traditionally and to a very high standard of workmanship. Machinery and labour costs were high compared to similar farms. Total machine hr/ha was 17.5 (though this figure did include some livestock work). Through changing crop establishment procedures from a multi-pass (ploughing, power harrowing and drilling) to a one-pass system, the farm was able to reduce the annual machine hours to 8.7. This gave an overall saving of £21 /ha on machinery and there was no apparent reduction in yield.

Combine Harvester Performance

Benchmarking the entire harvesting fleet has highlighted the range of performance being achieved on a machine by machine basis. The parameters we measure include tonnes per hour, hectares per hour, downtime, repair cost per hour and cost per tonne. Comparing individual machines, which in many cases are the same make and model, showed considerable variation in performance. For example, because of the many reasons why direct comparisons may not be fully justified, it was decided to work in conjunction with the manufacturer to improve the average machine output by organising an advanced operator and machine manager training day.

Figure 3. Combine harvester efficiency



By openly discussing problems and ideas on such issues as driver management, machine settings, harvest management and decision making, maintenance, and grain handling logistics, the overall performance of the fleet, in terms of tonnes per hour, was improved by 30% for the 2002 harvest (Figure 3). This achievement has reduced our harvesting costs by £1.70 /t,

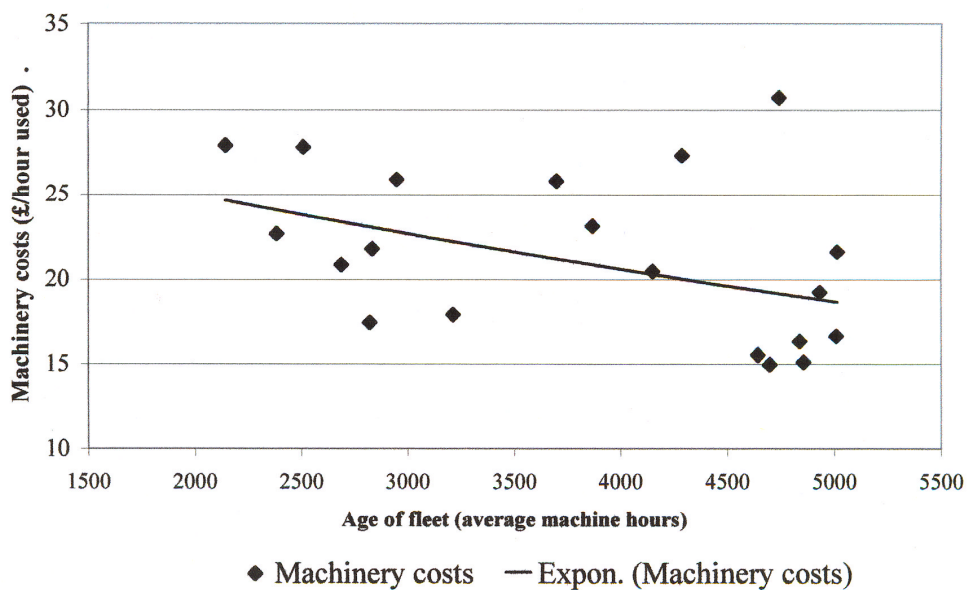
from £6.7 to £5 /t.

Achieving maximum economy of scale is difficult when key farm parameters are fixed. However, there are many solutions available which can be used to increase economies of scale - such as using external contractors, machinery rings, taking on more land or collaborating with a neighbour. For example, two of our farm businesses were experiencing high labour and machinery costs. Through a collaboration agreement, the two farms now operate with one fleet of equipment and one workforce. Significant savings have been achieved. At the same time there is no shared ownership of any labour or machinery, so each farm has retained its business identity. Labour and machinery costs of the combined operation are now 88% of the average of the three years prior to the collaboration agreement. And, equally significant, this system is achieving far better timeliness of operations, which has been reflected in increased yields.

Age of machinery fleet

In times of good profits, it was easy to justify regular machine replacement policies. The disappearance of profits has seen replacement periods extended. This places increased dependency on both operator skill and the availability of workshop facility so that the machinery can be properly maintained. With older machines, reliability becomes more of an issue and work plans need to allow for longer periods of downtime. In practice, by planning longer working-hours and/or by increasing machine capacity, the negative consequences of longer down-time can be largely offsets. Using the

Figure 4. Machinery costs: age of fleet.



achievements of actual farms to demonstrate possible cost saving, other Sentry farms have been able to re-structure their business along similar lines and been able to achieve net reductions in costs.

Once more, another example shows this. Our benchmarking data showed that farms with older equipment did not necessarily incur higher repair costs (Figure 4). Taking comfort from this fact, we have been able to increase the average age of machines in the Sentry fleet to 4,330 hrs. Five years ago, this figure was nearly 1,000 hours less. Many farms have increased capacity to cope with extra downtime, but these changes have reduced depreciation costs by over 30%, thus producing a net saving of £11 per hectare, whilst over the same period our repair costs have remained static. With no significant reductions in yield, it is assumed that timeliness of operations has not been significantly affected.

Cost of operations

It has long been argued that having equipment on-farm generated benefits of timeliness vis-à-vis relying on a contractor. However, within Sentry, we benchmark the cost of all operations against the cost charged by a contractor. We have found that it is often not possible to generate the economies of scale necessary to justify the purchase of a specialised piece of equipment. When equipment is likely to be under-utilised it is also likely to cost more than the use of a contractor.

For example, it was felt that the decision by a Sentry farm to take on additional land would stretch the farm's existing labour and machinery resources. In particular, the sugar beet harvester was about worn out and urgently needed replacing. After adding in depreciation, even with the extra land, the harvesting operation would cost around £200/ha, without allowing for any extra labour. The answer Sentry came up with may seem unconventional for a company specialising in operational farming – we organised an external contractor to harvest the sugar beet. The contractor harvested the entire crop at around £50/ha less than it would have cost to purchase his own machine.

Summary

With the benefit of hindsight, it is clear that many of the solutions to our problems were often staring us in the face. However, it took the process of benchmarking our performance to see many of these solutions. Benchmarking forces each farm manager to examine and justify the visible but also the less visible techniques and strategies they use. We have found that this exercise facilitates change, particularly because it is possible to get under the headline data to see which component of that headline figure is generating the good/poor performance. A new comfort zone has developed, not one based on subsidies, but one based on the ability to ring up the appropriate farm manager and discuss with him the appropriateness of following his blueprint to achieve low unit costs of production.

We know that we cannot afford to stop improving our businesses. Nor can we afford to stop competing for our share of the market place. It is clear

that measuring the exact benefit of “4 Thought” is difficult, as many of our changes may eventually have occurred without our benchmarking system, through natural development forced by the changing economic climate. However, we would argue that our natural development is ahead of many in the industry, and that is largely attributable to how we have used benchmarking.

Biographical notes

Trevor Atkinson has been involved with practical 'hands on' management of farms in Yorkshire, Nottinghamshire, Leicestershire, Northumberland and Warwickshire as well as Poland and Czech Republic. Running in parallel has been his interest in management information and how to use it to improve the decision making process at farm level. He is currently Technical Director for Sentry Farms Ltd.

REFEREED PAPER**PERCEPTIONS AND IMPACTS OF FRAM-A: A
NORWEGIAN FARM BUSINESS DEVELOPMENT
PROGRAMME**

O. Flaten and E. Kjesbu

The FRAM-A(gro) programme has been initiated to improve Norwegian farmers' business and strategic management skills. This article reports on an evaluation of the early projects. Key findings are that the learning model combining three approaches (theory, group learning and on-farm activities) was successful, and that farmers were satisfied with the one-to-one consultancy.

Key words: Training programme, farm development, strategic management, consultancy, evaluation

Introduction

Economic results are often found to differ considerably between farmers operating under more or less similar production conditions, suggesting that the management factor and human resources are important with respect to financial performance (e.g., Rougoor *et al.*, 1998). Each farm manager (called 'farmer' in the following) exhibits a certain level of managerial skill, which is a product of his or her personal characteristics and experiences. Can mature farmers' abilities in fact be altered? Giles and Stansfield (1990) and Nuthall (2001) have argued that appropriate formal training programmes can improve adult farmers' managerial skills. Recent empirical evidence is mixed. In Australia, Kilpatrick (2000) found training did change farm management practices and improved profitability, while Jackson-Smith *et al.* (2004) could not associate the training received by Wisconsin dairy farmers in financial management with evidence of improved financial performance.

In the past, most farmers had a strong production focus (*doing things right*). Farming success depended primarily on the ability to manage and develop an efficient operation. In the future successful farming will require a clear sense of what the farm is about and where it is headed. Efficiency is still required, but there will be a growing payoff to strategic decisions or *doing the right thing* (Miller *et al.*, 1998; Olson, 2004). Correspondingly, findings of a survey of Devon farmers highlighted the perceived need for training, particularly in business management, among farming families (Errington and Nolan, 1997).

Training programmes in farm business management are then one way to increase farmers' management skills and decision-making abilities. The public Norwegian Industrial and Regional Development Fund (SND) thus initiated a management and strategy development programme, FRAM-A(gro), for farmers. In FRAM-A 'the farm as a firm, and the farmer as a firm manager' is stressed. The programme has some unique features and new approaches to learning, which are presented with details of the programme in the next section.

This article reports on an evaluation of FRAM-A. The objectives are to

examine participating farmers' and consultants' perceptions of the programme regarding reactions, learning, and changes in behaviour, together with an assessment of the resulting outcome (economic gains). Although focused on a Norwegian programme, the results should also provide relevant insights and lessons for wider dissemination.

The article is in five parts. Part two describes the FRAM-A programme and its unique features. The evaluation methods are outlined in part three. Part four presents and discusses key findings in four sub-sections. The final section draws conclusions.

The FRAM-A programme

FRAM-A is a management and strategy development programme for farmers. SND has developed and manages the programme. The origin of FRAM-A is the general FRAM-programmes introduced in 1992, and designed for non-agricultural small and medium-sized enterprises (from one to thirty employees). Each year some 300 firms complete a general FRAM-programme, organised in regional project groups of up to 12 firms. The programme period lasts at least 1.5 years.

The first FRAM-A project groups were launched in seven counties in 2000. Three projects were completed at the time of this evaluation. Since these have been completed, over 15 new projects have been initiated. The programme costs are around NOK 90,000 per farm (£ 1 ≈ NOK 12.30), the farmer's share of these costs is NOK 10,000, with the balance paid by SND. Farmers have to pay accommodation, meals and travelling expenses themselves. Consultants' salaries are the programme's major cost.

The main objectives of FRAM-A are the same as the FRAM programme. These objectives can be grouped into quantitative and qualitative aspects. The quantitative aim is to improve the farm's financial result, clearly specified as an 'increased profit equal to 5% of the farm's gross output last year'. The four qualitative aims are, (1) positioning the farm business in order to achieve the profit objective and gain sustained competitive advantage;¹ (2) developing management skills; (3) defining and developing unique resources and core competencies;² and (4) developing cooperation, network and a 'farm board'. The farm board should include the farmer, his/her family, employees, and one or several external people. The qualitative objectives may appear to be quite general but they faithfully represent the declared aims of the programme.

The potential programme participants need to be interested in changing and improving their farm business, and in developing themselves. Other

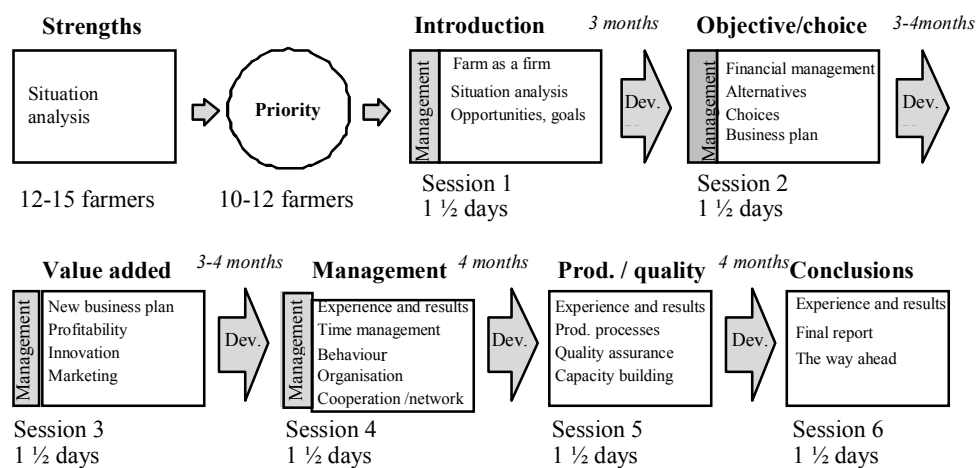
1. A firm experiences a *competitive advantage* when its actions create economic value and few competing firms are engaging in similar actions (Barney, 2002: p. 9). A firm experiences *competitive parity* when its actions add value but when several other firms are engaging in similar actions. Usually a farm represents a very small part of the total industry, so it will not be possible to gain a competitive advantage. In these circumstances, business strategy should focus on gaining competitive parity.

2. Distinctions among resources, capabilities and competencies can be drawn in strategic theory but they are likely to become badly blurred in practice (Barney, 2002:p.157). General practice suggests that core competencies are restricted to large firm attributes that enable managers to implement certain corporate diversification strategies. In this article the term resources will be used to describe strategically relevant attributes.

selection criteria include a track record of healthy financial performance and a larger than average farm size. Accordingly, FRAM-A participants are not a random sample of the farmer population.

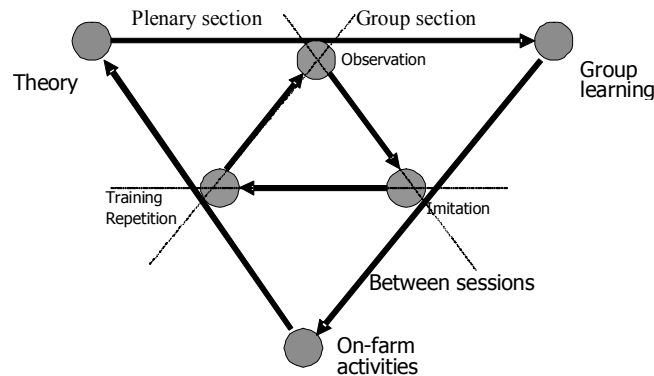
FRAM-A's process model shows the activities farmers are engaged in through a programme period of between 1.5 and 2 years (Figure 1). The programme begins with a situation analysis designed to increase the farmer's awareness of his situation and to start to identify potential areas of improvement and for development. Some farmers leave the programme at this stage. Those remaining usually form a group of 10-12 farmers who between them farm a range of enterprises. The next step is to evaluate possible options for change. The chosen options are set-out in each farmer's individual farm business plan. In total, farmers attend six sessions covering the subjects shown in Figure 1. Course coordinators, consultants, and other experts present lectures at these sessions. The sessions also allow farmers to exchange ideas and experiences through group work, and some social events are included.

Figure 1. FRAM-A's process model.



During the programme, farmers develop their human and farm resources in consultation with their allocated farm consultant. Each farmer is assigned about 60 hours of one-to-one consultancy, which takes place throughout the programme. They work together on the situation analysis, identification of opportunities and goals, plans of action and to develop selected projects. Farmers use the theory and experiences from the group learning on their own farm. The personal consultant aims to create a change-driven process, asks critical questions, and develops a trust-based relationship. Figure 2 summarises FRAM-A's learning model; it uses three main learning approaches; theory (structured education and training), group learning and on-farm activities.

A consultant is generally assigned 2-3 farmers, i.e., 4-6 consultants per project group. Consultants are recruited from two professions; consultants

Figure 2 The Learning Model.

with experience in business development and processes, and consultants with experience with farm business extension work. Often, agricultural consultants lack skills in business development and processes while general business consultants are seldom familiar with the uniqueness associated with farming and farm management.

FRAM-A's approach is to facilitate managerial changes through learning and development. This is a proactive way of encouraging change where farmers need to pay attention to the development of their business management skills, resources and motivation.

A number of FRAM-A's features distinguish the programme from more traditional extension services and training initiatives, at least in Norway. FRAM-A is a process-oriented programme operating at the whole-farm scale, aimed at developing both the farm *and* their human resources. Strategic planning and networking are stressed and the one-to-one consultancy plays an important role. While some parallels are found in other training programmes, the combination and extent of consultancy involvement underpinning FRAM-A is, in the authors' opinion, unique.

Evaluation methods and data

Kirkpatrick's (1998) four-level model for evaluating training programmes was used to evaluate the programme. Figure 3 shows the four levels (reactions, learning, behaviour, and results) and the variables that need to be measured at each level. Kirkpatrick's model goes beyond just using simple reaction questionnaires ('happiness sheets') to rate training programmes. This is because reaction levels are often weakly correlated with higher levels and, therefore, should be handled independently from the higher one's (Alliger and Janak, 1989); the higher the level, the more important it is for judging the success of the programme. However, the highest levels are the more complex to evaluate. In addition, when the qualitative objectives of the programme were agreed no clearly identifiable and measurable criteria were set out, making it harder to assess if these objectives had been met.

Figure 3. Kirkpatrick's (1998) four-level model for evaluating training programmes.

<i>Evaluation of</i>	<i>Question</i>
1. Reaction 	What were farmers' and consultants' responses to the programme?
2. Learning 	What did the farmers learn (knowledge, skills attitudes, etc.)?
3. Behaviour 	To what extent had new skills and resources been used in practice?
4. Resulting outcomes	To what extent had FRAM-A benefited farmers, had farmers improved their financial performance?

As a result, a mixture of quantitative and qualitative methods was used to examine the four levels. First, postal questionnaire surveys were conducted among FRAM-A participants (farmers) and consultants. The questionnaires included statements related to perceptions of: (1) the programme and its content; (2) changes in knowledge, attitudes, skills, etc.; and (3) changes in practice, and development of resources and network. Most questions were of the closed type in the form of Likert-scales ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaires were sent out in October 2002 to all 94 farmers and 35 consultants in the first eight project groups. In total, 53 farmers (56%) and 26 (74%) consultants responded. The questionnaires are documented in Vanebo *et al.* (2003).

All consultants estimated the change in their clients' financial performance through the programme period (objective 1 of FRAM-A), and reported these estimates to SND headquarter. This research was granted access to the consultants' economic reports for all of the farms in the first three groups that completed the programme.

After examining the questionnaires and these economic reports, we prepared semi-structured questionnaires to guide our interviews. The interviews addressed the same subjects and themes as the questionnaire survey, and, in addition, economic issues were explored. We conducted five focus group interviews with 3 to 5 randomly chosen farmers from five projects and personal, face-to-face interviews with 12 randomly chosen consultants from the same projects in November and December, 2002. Interviews with farmers were conducted in small groups to provide both in-depth discussion and opportunities for debating contrasting viewpoints. The interviews varied in length from 1-3 hours.³ Considerable insights into the attitudes of the interviewees and their perceptions of various aspects of the FRAM-A programme, including the resulting economic outcomes, were elicited through these qualitative interviews.

3. The interview guides are documented in Vanebo *et al.* (2003).

Results and discussion

Reactions

Some questions in the surveys were related to responses to the programme. Farmers and consultants were asked to score each statement on a Likert-scale from 1 (strongly disagree) to 5 (strongly agree). Key findings are presented in Table 1.

Table 1 Farmers' and Consultants' responses to the programme. (Scale: 1 = strongly disagree, 5 = strongly agree.)

	Farmers		consultants	
	Mean	SD*	Mean	SD*
I am very satisfied with the FRAM-A programme	3.83	0.92	3.92	0.89
I/farmers found FRAM-A very beneficial in my/their farm business	3.81	0.99	4.35	0.56
My/farmers motivation to develop new skills was very good during the FRAM-A programme	4.19	0.90	4.28	0.61
I am very satisfied with the sessions	4.02	0.66	4.00	0.71
I found the course literature very useful	2.62	1.15	2.77	1.34
I am very satisfied with my consultant	4.31	0.93	-	-
Farmers were very interested and active in the programme	-	-	4.42	0.86

* Standard deviation.

The survey indicated that both farmers and consultants found the programme interesting and beneficial. Farmers were highly motivated to develop new business management skills and found the sessions useful. In the focus groups, farmers were critical of some lectures presented during the programme period because they were not orientated towards the particular activities and decision-making environment found on farms and in farming. The opportunity to exchange experiences with other farmers was considered as the most beneficial aspect of this phase. Previous studies have also pointed out farmers' enthusiasm for business-related farmer discussion groups (e.g., Errington and Nolan, 1997; Kilpatrick, 2000).

The course literature scored low in the survey. The interviews revealed that a slightly modified version of the general, non-agricultural course material had been used. The literature was perceived as poorly adapted to farming, and it was too voluminous. Very few farmers had used the written course material; previous studies had also found that reading was not the preferred learning method of many farmers (Black, 2000).

Most farmers were satisfied with their consultant, and vice versa. In focus groups, some farmers stated that the consultant was the most important part of the FRAM-A programme. Trust-based consultant-farmer relationships were successfully built. Interestingly, the consultants' qualifications and attributes distinguished FRAM-A from other agricultural advisory services and training initiatives. Farmers assessed their consultants' knowledge and experience in

guiding processes as the most important influence, but farmers also expected their consultant to understand the cultural and social elements of the farming sector as well as being innovative. However, not all consultants were appropriately trained. Farmers proposed training consultants to develop their abilities, which reflects the positive experiences found in Denmark with initiatives to train consultants' to develop their strategic awareness and business competency (Lund and Larsen, 2002).

FRAM-A emphasises the profit-increasing goal, but farmers are rarely motivated by economic goals alone. Some farmers and consultants commented on the omission of non-economic issues as objectives. Cole and McGuinness (2001) have argued that consideration of social and environmental, as well as the economic aspects, of the farm business could increase the benefits of a farm business programme.

Learning

Through the combination of theory, group learning and on-farm activities (Figure 2), farmers were challenged to develop their knowledge, skills and attitudes. Their 'change capacity' (ability and will to make changes in the farm management practice) and their ability to self-develop, should have improved. Respondents in the survey were asked to score each learning statement, Table 2 summarises the important learning outcomes. Notice that the consultants' perceptions of farmers' learning results (and changes in behaviour which are discussed in the next sub-section) were more positive than the farmers' own perceptions. The differences may reflect a tendency for people to be unaware of their own improvements, in addition to the consultants' presumed self-interest in promoting the programme and their role in the programme.

The survey results indicate that farmers had increased their knowledge, particularly in strategy and business planning. However, the focus group discussions revealed that farmers were more sceptical of these outcomes. Some expressed having gained only a limited amount of new knowledge, but that the FRAM-A programme had rather inspired and motivated them to start using their latent knowledge more. These observations suggest that farmers had become more conscious about their knowledge and about actively using their knowledge.

The survey suggests that farmers had developed their skills in planning, time management and cooperation/communication. In the qualitative interviews we asked for information about farmers' skill developments, but little was forthcoming.

Some farmers' attitudes seemed to have changed during the programme period. "Increased awareness of where they wanted the farm to be in the future" was scored the highest by both farmers and consultants. "Profit orientation" had the second highest score by farmers. Consultants assumed farmers had become much more market oriented while many farmers perceived small, if any, change in this area. In focus groups however farmers revealed that they had become more demanding as customers and had increased their self-confidence. As one interviewee put it: *"It depends on self-confidence, pure self-confidence, believe in what you are doing, make a*

Table 2. Learning results in surveys of farmers and consultants. (Scale: 1 = strongly disagree, 5 = strongly agree.)

	Farmers		Consultants	
	Mean	SD*	Mean	SD*
Knowledge				
<i>FRAM-A has given me/farmers much useful knowledge in:</i>				
Economics and financial management	3.53	0.99	4.31	0.93
Strategy and business planning	4.04	0.78	4.58	0.76
Business administration	3.94	0.70	3.85	0.73
Marketing	3.19	1.08	3.50	0.91
Network development and cooperation	3.58	1.03	4.15	0.73
Production, quality assurance	3.23	1.10	2.96	0.87
Skills				
<i>I/farmers have developed my/their skills considerably through the FRAM-A process in:</i>				
Planning	3.83	0.98	4.27	0.60
Time management	3.70	0.85	4.15	0.73
Cooperation and communication	3.60	0.87	4.12	0.67
Attitudes				
I/farmers have become much more market oriented	3.11	1.10	4.42	0.50
I/farmers have become much more profit oriented	3.91	0.95	4.38	0.70
I/farmers have become more aware of external conditions affecting the farm operation	3.49	1.03	4.27	0.72
I/farmers have become more aware of utilising the farm's opportunities and resources	3.70	1.03	4.50	0.58
I/farmers have become more aware of where I/they want the farm to be in the future	4.06	0.99	4.65	0.56
Change capacity				
My/farmers barriers to make changes have been reduced	3.23	1.07	4.19	0.90
FRAM-A has strongly motivated me/farmers to make changes in the farm business	3.57	1.07	4.27	0.83
Self development				
I/farmers have become much more aware of what I/they want to do, can do and should do	4.00	0.81	4.46	0.65
I/farmers have become more creative and have discovered new opportunities	3.32	1.00	4.15	0.61
I/farmers have become a better decision maker	3.36	0.96	3.77	0.76
I/farmers have become better to implement planned projects	3.62	0.97	4.58	0.72

Standard deviation.

decision and go for it." Similar statements in other focus groups and personal interviews suggest that farmers had become more aware of decisions making.

In the survey, farmers perceived FRAM-A had only a modest effect on their barriers and motivations to make changes ('change capacity'). However, the consultants' assessments of FRAM-A were much more positive. Answers to questions not shown in Table 2 revealed that few farmers found their own attitudes and skills were barriers to change; market opportunities and farm

policy were regarded as more important barriers. Consultants perceived farmer traditionalism as the farmers' most important barrier to change.

Marnburg (2000) proposed that the self-developing small firm has the ability to develop innovative thoughts and to consider new opportunities, and that the self-developing firm should not view itself merely as a product of its surroundings. Developing strategies for allowing firm's to influence their own surroundings are equally important. The survey indicated that the highest perceived impact of FRAM-A was on farmers' awareness of what they wanted, could and should do. Skills relating to the implementation phase had improved. However, farmers perceived that FRAM-A had only a slightly positive effect on creativity and decision-making skills. The interviews revealed the role of sessions as a time for the exchange of experiences and ideas, motivation and for innovative thoughts. A mixture of the sessions and discussions with consultants, left farmers more motivated and energised to develop their farm businesses.

Overall, farmers' resources and 'change capacity' were developed. They had become more aware of their situation as a farmer and of where they wanted the farm to be in the future. Self-development abilities had improved. Whether the new managements skills and abilities changed behaviour is the next question addressed.

Behaviour

Perceptions of changes in behaviour were divided into three groups in the questionnaire survey: change in practice, developing unique resources, and network development. Some findings are presented in Table 3.

FRAM-A stresses that budgeting and management accounting are important to the farm's system of financial control. In spite of this, relatively few farmers had intensified their budgeting and accounting activities. This observation could be related to Hardaker and Anderson's (1981) suggestion that farm-recording systems are doomed to failure because the products do not meet the needs of most farmers because of the nature of their decision making processes. There is, for example, little point in carefully matching farm records against a budget when wide divergences between actual and planned results occur all too frequently and for reasons that a farmer usually cannot influence at all.

Almost all farmers had completed a business plan together with their consultant (as required by the programme). One outcome was that some farmers had negotiated better business deals; in the focus groups, farmers commented that they had become tougher negotiators and traders.

One of FRAM-A's main messages is the need for 'economic thinking'. Farmers' average score of 3.74 on profitability suggests that FRAM-A had some success in this respect. Moreover, in focus groups farmers argued that their understanding and use of principles in managerial economics had improved, but more training in financial management was still needed. Many farmers had implemented new projects to increase profitability, but the interviews and focus groups revealed that few farmers had actually started new enterprises or moved into a differentiated product strategy; most had decided

to add value to existing activities.

*Standard Deviation.

Table 3. Perceptions of farmers' changes in behaviour. (Scale 1 = strongly disagree, 5 = strongly agree.)

	Farmers		Consultants	
	Mean	SD*	Mean	SD*
Change in practice				
I/farmers have started management accounting, and/or use accounting systems more actively in decision making	3.09	1.27	3.92	0.89
I/farmers have developed a business plan	3.91	1.21	4.62	0.57
I/farmers have contacted suppliers and/or customers to get better deals	3.42	1.42	4.35	0.56
I/farmers manage the farms, more than before FRAM-A, out of profitability concerns	3.74	0.98	4.08	0.74
I/farmers have implemented many projects through FRAM-A to increase profitability	3.79	1.06	4.62	0.64
Developing unique resources				
I/farmers have identified my/their strengths and unique resources	3.92	1.07	4.50	0.58
I/farmers have decided to phase out some enterprises or production systems	3.32	1.46	4.42	0.81
I/farmers have identified enterprises or production systems that should receive more focus	3.77	1.25	4.35	0.63
Network development				
I/farmers have developed new contacts	3.51	1.34	4.15	0.88
I/farmers have made more use of my/their existing network	3.79	1.15	4.38	0.75
I/farmers have established a farm board	2.57	1.60	3.65	0.98

The FRAM-A programme expects farmers to define and develop their unique and valuable resources so as to gain a sustained competitive advantage. According to the surveys, many farmers had identified their strengths and weaknesses and surveyed the external business environment. These findings agreed with the responses in the focus groups, as a farmer illustrated: *"One of the most important lessons from FRAM-A is the competitive advantage we have, and what we can do better than most others. Now I am sure where to invest and allocate my resources"*. Many farmers seemed to have developed a clear vision of where the farm operation was headed and were expected to have identified business strategies to gain competitive advantages.

One of the FRAM-A programmes aims was to develop networks, cooperation and a farm board. Relatively few farmers claimed to have developed many new contacts, but they had become more aware of their existing networks. Consultants were more positive. In focus groups farmers expanded on their more critical and demanding view of the traditional advisory service. A typical reaction was: *"We have become more critical to*

agriculture's traditional advisory service. We want to acquire knowledge from those who have something of value to offer." A farmer replied he had changed accountant because his former firm could not offer the services he now required.

Few farmers found the establishment of a farm board useful. In focus groups, farmers commented that setting-up of an internal, formalised farm board was a waste of time and too bureaucratic, because the farmer and perhaps the spouse were the only people involved in the farm operation. Olson (2004:p. 354) pointed out that a board of external advisors could be a valuable management tool in farms of any size. These boards could, in theory, help farmers understand and prepare for the increased complexity involved in running a farm business. Perhaps it would be more appropriate to establish a board of advisors instead of a more internally-focused farm board.

To summarize, farmers' immediate behaviour were perceived to have changed. Farmers should however bear in mind that, for instance, one-off strategic planning efforts seldom create sustained success (Miller *et al.*, 1998). Rather, strategic planning is a process, which needs to be continuously revisited. Whether the behavioural changes are merely temporary or will be permanent is unknown, and this will need to be evaluated at some time in the future.

Resulting outcomes

The resulting outcome of FRAM-A should be increased farm profit. A quantitative target was specified, that of achieving an 'increased profit equal to 5% of the farm's gross output in the previous year'. Whilst the farmer and the consultant jointly planned the profit-improving activities, it was the consultants' responsibility to prepare estimates of the economic impacts of these activities in the form of a budget. Changes in the profit and loss account's net farm income⁴ from the year of the situation analysis and two years later were calculated and used to indicate whether the profit target had been achieved.

Reports from 31 farms in the three completed programmes showed an average profit improvement of NOK 198,000 per farm. Given that their average profit target was an increase of NOK 69,000 (i.e. average farm gross output of NOK 1,380,000), the results suggested high gains relative to programme costs. However, estimating the future change in financial performance and then attributing these changes to specific training programmes are both inherently difficult tasks (Marsh and Pannell, 2000). Clearly a wide range of factors, only one of which is the training programme will influence changes in financial performance. To show improvement over past results, any trend analysis of farm performance must take into account year-to-year changes in weather, prices, and many other random variables (Kay and Edwards, 1999; p. 338). In the completed FRAM-A programmes, improvements in the financial performance between 1999 to 2001 were recorded. The measured profit improvements were assisted by higher milk,

4. Net farm income is the return to all farm assets, unpaid labour and management contributed by the family/operator to the farm business.

meat and livestock prices in 2001 compared with the weak markets experienced in 1999. No adjustments were made in the calculation to correct for these changes which are outside the control of individual managers. Moreover, some consultants included in their calculations the higher sums earned from off-farm income as a part of the farm's profit improvement.

Net farm income calculates the return to more than one input. Deductions for unpaid labour input and returns to farm assets were not taken into account in calculating the FRAM-A definition of profit. As a result of the programme, it was quite common to find that farms expanded and employed more unpaid labour and made additional investments. Given the FRAM-A programme's focus on human resource development, perhaps 'return to management' (the residual return to the owner for the management input) would have been a more appropriate measure of profit. In focus groups, farmers were very critical of the profit measures used to assess the programme, and some consultants expressed similar views. Overall, there was a consensus that the farm business analyses inadequately measured the financial impacts of the programme, and the estimates that were produced were likely to have overestimated the real financial impact.

Farmers however found FRAM-A's emphasis on economics and financial performance attractive. They mentioned a large number of activities already implemented that are expected to increase farm income. FRAM-A should also improve longer-term farm positioning, but to identify impacts on long-term profitability and viability, an evaluation period of 5-15 years would be necessary.

Programme costs are high, and this may raise concerns relating to the justifications for spending public and private funds on the programme. Consultants' fees are the programmes major expenditure, therefore it is important to ensure efficient use of appropriate consultants. Moreover, the one-to-one consultancy in FRAM-A involves considerable elements of private benefits to farmers (a private good), which suggests that the costs could be borne more heavily by the recipients. However, farmers and consultants were united in their scepticism of this development, fearing that any increase in the user's fee above NOK 15,000 would significantly reduce the programmes benefits, because participants' would be uncertain as to benefits they would derive from the programme at its outset.

Conclusions

FRAM-A is a process-oriented whole-farm approach to delivering farm business advises in Norway. It is designed to focus on business development, strategic planning and developing networks. The outcome of the FRAM-A pilot groups has been assessed using Kirkpatrick's four-level model for evaluating training programmes. When the qualitative objectives of the programme were set-out they lacked any clearly identifiable criteria that could be measured, thus making it harder to assess if those objectives had been met. A mixture of methods (questionnaire survey, focus group interviews, personal interviews and document analysis) was employed to judge the success of FRAM-A. In summary, the consultants' perceptions of the programme were generally more positive than farmers' perceptions.

A number of features in FRAM-A that appeared to benefit farmers were identified. The learning model, combining three approaches (theory, group learning and on-farm activities), was well received and considered successful. Farmers were satisfied with the one-to-one consultancy. The process approach distinguished FRAM-A from the traditional products provided by the extension service. FRAM-A succeeded in linking participating farmers with one another, and in widening their network. Farmers' knowledge and skills in strategy and business planning improved, their willingness to make changes to their farm business, and their self-development, were facilitated. Unique farm and farmer resources were identified. Many farmers seemed to have developed a clearer vision of where the farm operation was heading and had identified business strategies to gain competitive advantages.

Some initiatives in FRAM-A were less successful. Few farmers had implemented new routines in budgeting and financial control; improvements in the written course material were required and farmers did not find the establishment of an internal formalised farm board useful. The failures were somewhat related to FRAM-A's lack of adjustment of the teaching materials to accommodate the production and business characteristics of farming, based as it is on weather related uncertainties and biological and human complexities.

Consultants' profit estimates suggested very high programme gains, but the methodology and measures used were inadequate. For example, no adjustments were made to correct for the impact of changes in variables outside managerial control (e.g. improvements in market prices). Farmers, however, informed us of the many activities they have initiated as a result of the programme, and which they expect will increase their farm incomes. A further examination of the relationship between FRAM-A's development of managerial and strategic skills, and the evaluation of how this impacts on long-term profitability and viability is recommended.

The generally positive perceptions and impacts suggest that FRAM-A contains a high proportion of 'good-practice' elements, and that it is a useful instrument for improving farmers' management skills. All participants regarded the one-to-one consultancy as one of the most powerful elements of the programme; at the same time consultants' salaries are the major programme cost. Efficient use of the consultancy is clearly an important concern in order to justify the costs of the programme to the public purse.

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REFEREED PAPER

**THE LUXEMBOURG COMMON AGRICULTURAL
POLICY REFORM AGREEMENT: IRISH DAIRY
FARMERS DEVELOPMENT OPTIONS**

L. Shalloo, P. Dillon, M. Rath, and M. Wallace

A stochastic whole farm simulation model was used to simulate business performance and financial risk of a typical specialist dairy farm in Ireland over the period 2004 to 2013 for eight investment and management strategies. Projected prices and costs were included along with changes in dairy policy arising from the 2003 Luxembourg CAP reform Agreement. Dairy farmers that opt to remain static can expect a large reduction in income (~30% in real terms). Expansion using low cost animal housing or use of existing buildings (e.g. conversion of beef accommodation) facilitates the greatest scope for increased income and cash flow.

Keywords: farm net profit, cash flow, dairy farming, Luxembourg agreement, risk, Ireland.

Introduction

Since joining the European Community in 1973, milk producers in Ireland have enjoyed relatively high milk prices due to the support system of Common Agricultural Policy. However, dairy farmers are now facing important changes to their economic environment. In particular, the Luxembourg agreement on the reform of the CAP (Mid Term Review) entails a fundamental change in agricultural policy with the decoupling of support measures from production. In Ireland, full decoupling is to be introduced from 2005 and milk price is projected to fall by 5 to 5.5 cents per litre due to reduced price support for butter and skimmed milk powder. These changes mean that many dairy farmers need to reappraise their business strategy and consider necessary adjustments that will ensure viability in the longer term.

In assessing any business investment, particularly for a family business such as a farm, two aspects require consideration: the impact on farm profitability and its financial feasibility. The profitability of the investment is often regarded as a long-term matter. Estimating the long-term implications of any decision on future profitability has become extremely difficult in the uncertain agricultural climate and therefore must be based on sound economic principles. The financial feasibility will often depend on the ability to meet commitments arising from increased borrowings that may involve a significant exposure to financial risk taking. For example a couple of bad years in milk production and an unexpected rise in interest rates could result in a bankrupt business. The risk is likely to be most severe in the first years after the investment when debt is at a peak.

In this analysis the Moorepark Dairy Systems Model (MDSM) (Shalloo *et al.*, 2004) was used to simulate the business performance and financial risk of an average specialist dairy farm in Ireland over a 10-year period using eight alternative investment and management strategies. Based on analysis by FAPRI-Ireland Partnership (Binfield *et al.*, 2003), projected prices and costs

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were incorporated along with changes in dairy policy arising from the 2003 Luxembourg CAP reform Agreement. Financial risks associated with the individual investment strategies were evaluated using estimated cumulative distribution functions (CDFs) for projected profit under each alternative.

Methodology

The Moorepark Dairy Systems Model (MDSM) (Shalloo *et al.*, 2004) is a stochastic budgetary simulation model formulated within a Microsoft Excel spreadsheet. The model integrates animal inventory and valuation, milk supply, feed requirement, land and labour utilisation and economic analysis. Land area is treated as an opportunity cost with additional land rented in when required and leased out when not required for on-farm feeding of animals. Variable costs (fertiliser, contractor charges, medical and veterinarian, AI, silage, reseedling), fixed costs (machinery, maintenance and running costs, farm maintenance, car, telephone, electricity and insurance) and prices (calf, milk and cow) are based on current prices (Teagasc, 2002).

A spring calving, grass-based milk production system, representative of that operated on most Irish dairy farms (Dillon *et al.*, 1995; Kennedy *et al.*, 2002), was simulated using the model. The feeding and management were based on current best practices in seasonal spring calving pasture-based systems (O'Donovan, 2000). The proportions of feeds offered (grass, grass silage, and concentrate) were altered to meet the net energy requirement for milk production, maintenance, and bodyweight change (Jarrige, 1989). A fixed feeding system was used for young stock as per Teagasc guidelines (Teagasc, 2002). In the scenarios where dairy cow numbers were expanding it was assumed that milk production per cow remained static from 2004 to 2008 (expanding years) and between 2009 to 2013 increased by 1% per year. In the case of the scenarios where cow numbers were static, it was assumed that milk production per cow increased by 1% per year.

Both variable and fixed costs (not including labour) were increased on average by 1.34% and 2.5% respectively per year for period 2004 to 2013 to take account of the effects of inflation based on projections from FAPRI-Ireland Partnership (Binfield *et al.*, 2003),

Labour requirements were based on data from the Moorepark Labour Study (O'Donovan, 2003). At a herd size of less than 50 cows, labour requirement was 50.5 hours/cow/year, between 50 and 60 cows it was 46.1 hours/cow/year, and at a herd size of greater than 60 cows 35 hours/cow/year of labour was required. No cost was assumed for the first labour unit, while any extra requirement was charged at €12.40/hour. The book value for the existing buildings and machinery were those for the sixth and seventh year since building or purchase respectively. A 15-year bank loan at 7.3% interest was used to fund the cost of these. Investment in milking facilities was increased by €3,174 for each additional 7 cows in the herd, which was financed by a 15-year loan at 7.3% interest.

Stochastic budgeting

Stochastic simulation of the MDSM was undertaken through a process of 'Monte Carlo sampling' using the computer software @Risk (Palisade, 2000).

Monte Carlo Risk Assessment specifies a probability distribution for each sensitivity parameter, draws a set of those parameters, and repeats the conventional analysis for multiple draws (Phillips, 2000; Phillips and Maldonado, 1999). A sufficiently large number of simulations were run (10,000) with the same input distributions, so that the probability distribution functions (PDF) of the outputs were adequately described (Isukapalli *et al.*, 1998).

Stochastic budgeting was used to model the influence of variations in milk price and interest rate. The variation in milk price over the period 1995-2002 was estimated from observed price data obtained from the Central Statistics Office (CSO, 2003). An empirical probability distribution for milk price was estimated using Bestfit (Palisade, 2000). This identified a Beta General distribution as the optimum distribution for representing variability in the milk price data. The Beta General distribution is characterised by four parameters (α_1 , α_2 , minimum, maximum). It is an extremely flexible distribution that specifies minimum and maximum values and employs two parameters to define the shape of the distribution.

Variation in interest rate was simulated as a triangular distribution. The most likely, minimum and maximum values were 4%, 2% and 6% for the money borrowed for quota purchase and 7.3%, 5.3% and 9.3% for all other borrowings. The two stochastic variables were assumed to be uncorrelated and were then simulated together within the model.

The farm used in this analysis was the average specialist dairy farmer from

Table 1. Key herd default parameters used in the model.

Scenario Variable	2004	2013		
		S1	S3, S4, S5.	S6, S7,S8.
Land area (ha)	44.5	44.5	44.5	44.5
Cow numbers	42	38.4	62	84
Quota size (kg)	209 000	209 000	322 053	430 993
Milk yield pre cow	5000	5414	5203	5203
Ave. stocking rate LU/ha.	1.7	1.9	1.9	1.91.9

the Irish National Farm Survey (NFS) in 2003. Table 1 shows the key herd default parameters used in the economic model. in 2004 and 2013.

Table 2 shows the key projected costs and prices used in the model based on analysis conducted by FAPRI-Ireland (Binfield *et al.*, 2003). The aggregate impact of Agenda 2000 and the Luxembourg agreement on the reform of the CAP will result in a reduction in the intervention price for butter and skimmed milk powder of 25% and 15% respectively by 2007. Based on these reforms, FAPRI-Ireland Partnership project that Irish farm milk price will reach a level of approximately 22 cents per litre by 2012 (Binfield *et al.*, 2003). A dairy compensation package, calculated from quota held on 1 April 2005, will partially offset these milk price reductions. The compensation will be equivalent to 1.18 cents per litre in 2004, 2.36 cents in 2005 and from 2006 onwards 3.5 cents per litre. For beef the decoupled direct payments are based on the average number of premia claimed in the reference period of 2000 to 2002. All farm payments are subject to reductions of up to 3% in 2005 to

Table 2. Key projected prices and costs variables used in the model farm 2004 to 2013.

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Male calf price (€)	190	89	89	91	94	97	99	102	104	107
Land opportunity cost (€/ha)	471	267	267	267	267	267	267	267	267	267
Concentrate cost (€/t)	190	189	187	185	185	183	182	180	180	180
Cull cow price (€)	381	262	265	270	277	283	290	296	300	300
Labour cost (€/hour)	12.4	12.6	13.0	13.5	13.8	14.2	14.6	15.1	15.5	15.5
Milk price (c/kg)	24.9	24.0	23.2	22.6	22.4	22.4	22.2	22.0	22.0	22.0
Decoupled payment (€)	2 779	10 515	13 053	12 639	12 639	12 639	12 639	12 639	12 639	12 639
Quota price (c/l)	31.0	19.9	19.1	18.6	18.5	18.4	18.3	18.1	18.1	18.1

create a National Reserve to cater for hardship cases. Similarly Single Farm Payments (SFP) over €5,000 will be subject to modulation at a rate of 3% in 2005, 4% in 2006 and 5% from 2007 onwards. To receive the SFP farmers will have to adhere to requirements set down in EU Directives covering areas such as environment, identification and registration of animals, animal and plant health and animal welfare. From 2005 onwards male calf price, cull cow price and opportunity cost of land are reduced because of decoupling direct payments from production, i.e. the SFP will be obtained independent of production.

Investment strategies investigated

A total of 8 alternative investment and management strategies were investigated over the period 2004 to 2013. In the expansion scenarios, increased cow numbers were obtained from within the herd replacements and additional milk quota was purchased at 80% of milk price in each year of purchase and was financed by a 5-year loan at 4% interest. The quota purchase price from 2005 onwards was much lower than in 2004 (30 cent/l) because the SFP is decoupled from milk price. Since the future of EU milk quotas is uncertain beyond 2014, the additional milk quota purchased was depreciated in value to zero by 2014. The additional milk quota purchased over the period 2005 to 2008 for both 50% and 100% expansion scenarios was in line with increased cow numbers.

The selected investment and management scenarios were:

Scenario 1 (S1): Continue as 2003 or static option. No change in overall production between 2004 and 2013, but the farming system is subjected to inflation, reduced milk price and modulated direct payments.

Scenario 2 (S2): In this scenario an extensive system of milk production is modelled. The farmer participates in the Rural Environment Protection Scheme (REPS). To comply with this scheme the maximum total allowable N input is 260 kg/ha, while total organic N cannot exceed 170 kg/ha. To model a sustainable REPS system the stocking rate was reduced to 1.85 cows/ha, using 100-kg N/ha, which is equivalent to a total N input is 257 kg/ha and an organic loading of 157 kg/ha (1.85*85). The REPS scheme in Ireland allows a payment of €200/ha for the first 20 hectares, €175/ha for the next 20 hectares and €70/ha for the next 10 hectares. Cost of compliance with REPS was taken as an increase of 21% in fixed costs per year (McEvoy, 1999). This relates to increased investment in slurry storage, record keeping, stock-proofing boundaries, maintaining habitats, restricting access to watercourses etc.

Scenario 3 (S3): This entailed a 50% increase in milk production using conventional housing. Cow numbers were increased by 50% between 2004 and 2008. This is achieved by rearing 65% of female calves for replacements as opposed to 55% in S1. As herd size increases the additional cows are housed in a conventional type house at a cost of €1591/cow (Teagasc, 2002), which is financed over 15-years at 7.3% interest. The overall farm stocking rate remains the same as the dairy enterprise increases and alternative

enterprises are reduced.

Scenario 4 (S4): Similar to S3, S4 entailed a 50% increase in milk production but using low cost housing. The additional cows are wintered on a standoff pad and an earth bank tank is used to contain slurry and soiled water. This system has a cost of €262/cow (Teagasc, 2002), which is financed with a 15-year loan at 7.3% interest.

Scenario 5 (S5): S5 is similar to S3 and S4, which entails 50% increases in milk production but with no increase in housing costs. In this scenario it is assumed that there is adequate housing available for the 50% increase in cow numbers (i.e. the housing made available from the reduction in alternative enterprises is adequate to house the extra cows).

Scenario 6 (S6): This scenario is similar to S3 in that conventional housing is used to house the increased cow numbers, however milk production increases by 100% over the 10 year period. To achieve this increase in milk production 85% of female calves are reared for replacements.

Scenario 7 (S7): This scenario is similar to S4 in that additional cows are wintered on a standoff pad and an earth bank tank is used to contain slurry and soiled water, however milk production increases by 100% over the 10 year period. To achieve this increase in milk production 85% of female calves are reared for replacements.

Scenario 8 (S8): This scenario is similar to S5 in that no additional cow housing is required, however milk production increases by 100% over the 10 year period. To achieve this increase in milk production 85% of female calves are reared for replacements.

Results

Table 3 shows the trends in net farm profit (Loss) for 2004 to 2013 for the

Table 3. Trends in net farm profit (loss) (€) for eight milk production scenarios, 2004 to 2013.

Year	Scenarios investigated.							
	S1	S2	S3	S4	S5	S6	S7s	S8
2004	36 450	37 866	31 302	31 302	31 302	27 268	27 268	27 268
2005	34 986	37 606	36 919	28 508	28 679	22 872	25 567	26 087
2006	36 323	39 351	27 235	30 061	30 332	16 652	21 610	22 567
2007	35 602	38 796	22 533	26 507	27 017	17 744	25 266	26 717
2008	35 575	38 919	31 427	36 716	37 364	17 637	28 085	30 102
2009	35 899	39 371	37 958	42 308	42 794	32 215	40 664	42 253
2010	35 909	39 494	39 027	43 147	43 491	34 269	42 162	43 538
2011	35 734	39 417	39 549	43 335	43 659	35 391	42 658	43 927
2112	36 313	40 041	41 125	44 592	44 896	37 834	44 581	45 668
2013	36 168	40 009	41 409	44 572	44 853	38 645	44 853	45 802

eight milk production scenarios.

In S1 the net farm profit in 2013 (nominal terms) is similar to that in 2004. In all six-expansion scenarios (S3, S4, S5, S6 S7, and S8) the net farm profit in the first four years is lower than in either S1 or S2, while in the last six years the expansion scenarios are more profitable. Relative to S1 in nominal terms, the net farm profit in 2013 is +10%, +14%, +22%, +23%, +6%, +23% and +26% for S2 to S8 respectively.

Table 4 shows the trends in net cash flow for 2004 to 2013 for the eight milk production scenarios. Similar to the net farm profit, the net cash flow in the first four years is lower in the six expansion scenarios than either S1 or S2, while in the last six years the six expansion scenarios are greater. Relative to S1 in nominal terms the cash flow in 2013 was +2%, 17%, 25%, 26%, 23%, 38% and 41% for the S2 to S8 scenarios respectively.

Table 4. Trends in cash flow (€) for eight milk production scenarios, 2004 to 2013.

Year	Scenarios investigated.							
	S1	S2	S3	S4	S5	S6	S7s	S8
2004	42 772	44 188	37 696	37 696	37 696	33 802	33 802	33 802
2005	41 069	43 924	29 305	30 648	30 907	22 695	25 149	25 622
2006	41 976	45 004	34 313	36 475	36 892	25 095	29 243	30 043
2007	40 864	44 058	29 826	32 891	33 482	26 984	33 148	34 338
2008	40 487	43 831	42 583	46 644	47 428	36 472	45 037	46 689
2009	40 497	43 970	47 127	50 282	50 891	46 235	52 739	53 995
2010	40 225	43 810	46 731	49 886	50 495	45 496	52 001	53 256
2011	39 796	43 479	47 980	51 136	51 744	47 913	54 418	55 673
2112	40 044	43 772	49 528	52 683	53 292	50 655	57 160	58 415
2013	39 633	43 443	50 134	53 289	53 898	52 713	59 218	60 473

Table 5 shows the total discounted farm profit and increase in net worth (livestock only) for all eight scenarios over the 10 years. The highest discounted farm profit was for the REPS system (S2), while the least profitable option was expansion with conventional housing (S3 and S6). When changes in net worth due to increases in cow numbers were considered, systems based on expansion with no increases in capital cost were most

Table 5. Total discounted farm net profit and changes in net worth for the eight milk production scenarios 2004 to 2013.

Scenarios	Farm net profit €	Changes in net worth €
S1	310 447	-
S2	337 516	-
S3	288 169	22 544
S4	315 684	22 544
S5	318 489	22 524
S6	237 182	44 314
S7	289 550	44 314
S8	299 049	44 314

profitable (S5 and S8).

Stochastic Budgeting

Figure 1 shows a cumulative density function (CDF) of the influence of variation in milk price and interest rate on the distribution of farm profit for S1 - S5.

Figure 1. Cumulative probability distribution showing the influence of milk price and interest rate on net profit for the S1 to S5 scenarios.

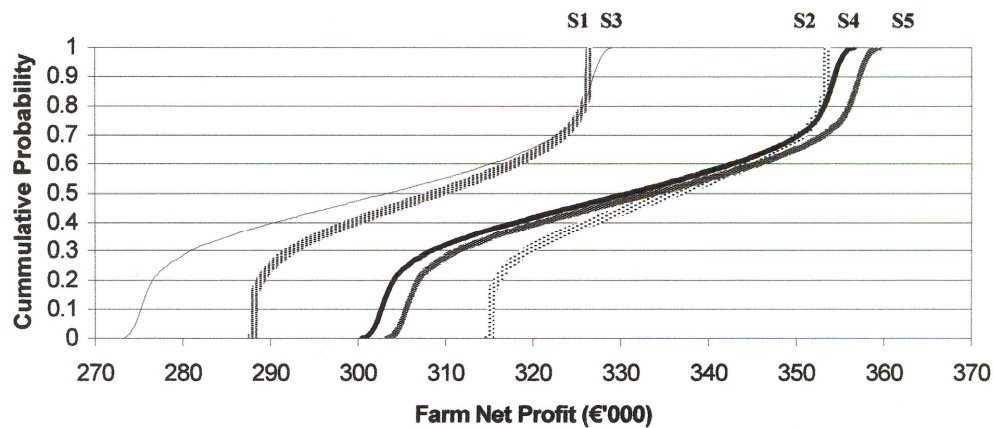
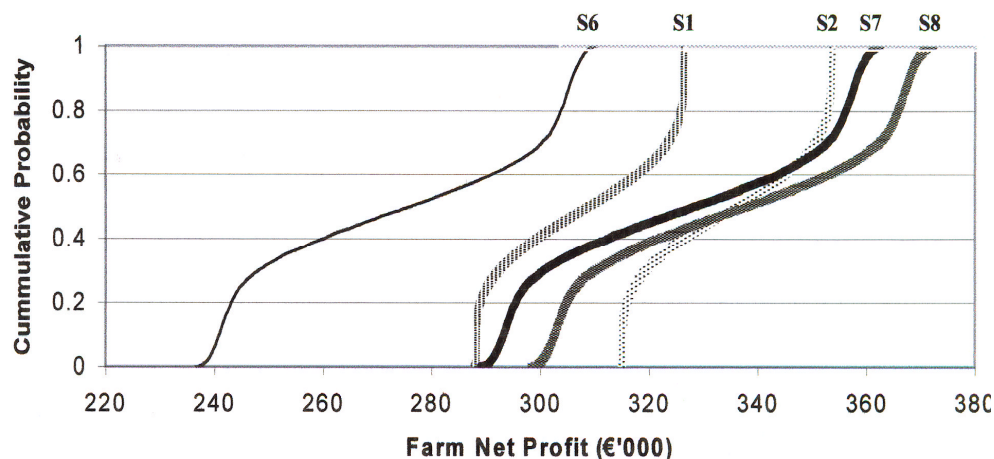


Figure 2 shows a cumulative density function (CDF) of the influence of variation in milk price and variation in interest rate on the spread of farm profit for S1, S2, S6, S7 and S8. The cumulative probability distribution showed that the stochastically dominant option was dependent on the level of

Figure 2. Cumulative probability distribution showing the influence of milk price and interest rate on net profit for the S1 S2 and S6 to S8 scenarios.



risk aversion of the decision-maker. First degree stochastic dominance means that the CDF further to the right are preferred. This means that for any given level of risk there is a higher level of profit or conversely for a given level of profit there is lower risk when the CDF is further to the right. For a more risk averse farmer the S2 scenario was stochastically dominant while for a less risk averse individual S4, S5, S7 and S8 were preferable. The mean farm profit was €310,457, €337,526, €288,123, €315,650, €318,500, €237,078, €389,541 and €299,060 for S1 to S8, respectively. The range in farm profit with a 90% confidence interval (5% to 95%) was €289,823 to €329,846 in S1, €316,607 to €357,227 in S2, €260,942 to €313,760 in S3, €288,645 to €341,106 in S4, €291,484 to €343,875 in S5, €203,323 to €268,968 in S6, €256,321 to €320,806 in S7 and €265,892 to €330,346 in S8. Evidently, the modest extra profit obtainable with some of the expansion scenarios would, for some decision-makers be insufficient to justify due to the extra risk involved; which will also depend on the farmers attitude toward risk.

Discussion

In 2002, Agenda 2000 was reviewed and after much debate on June 26 2003 a new policy framework for EU agriculture was agreed, namely the Luxembourg CAP Reform Agreement. For milk producers the main feature of the Luxembourg Agreement was a further reduction in intervention prices, compensation for the expected reduction in milk prices would be paid in the form of Single Farm Payment and decoupling of dairy, beef and sheep premia from production. This meant that producers were no longer required to produce milk, calves or other livestock in order to receive the premia payment. A number of decoupling decisions were left to the decision of the Member States, i.e. a choice to link certain livestock payments to production and Member States were allowed to choose the date from which the dairy compensation payments should be decoupled. Ireland opted for full decoupling of all beef payments; ewe premiums and arable aid payments; as well as dairy cow premium from 2005, all of which have been included in the present study. In recent months there has been some clarification on rules on the implementation of payment of the SFP. These include that payment of the SFP will depend on cross-compliance where farmers must adhere to requirements set down in EU Directives. Individual farmer's entitlements will be reduced by up to 3% in order to create a National Reserve. The number of entitlements will be determined by dividing the SFP by the average number of hectares declared over the period 2000, 2001 and 2002. In order to activate these SFP in 2005 a farmer is required to have one eligible hectare of land for each payment entitlement. This would have resulted in serious problems for those farmers who might (for specific reasons) have wished to declare less land in 2005 or in subsequent years. This was changed to allow certain categories of farmers to consolidate payment entitlements to the number of hectares declared in 2005 to equal to at least 50% of the average number of hectares declared during the reference period. These implementing rules do not invalidate the methodology used in this present analysis.

Each of the eight options are discussed in relation to farm net profit, cash flow, total discounted net farm profit and variations in farm profit brought

about by variation in milk price and interest rate. When evaluating system options for a business it is important to have a number of different indicators of the financially optimum (Thomas *et al.*, 1997; St-Pierre *et al.*, 1999) as the one that returns the highest profit may also be associated with the largest level of risk.

All scenarios with the exception of S1 showed a higher net farm profit in nominal terms in 2013 than in 2004. Adjusting for an estimated inflation rate of 3% (Department of Finance, 2003) the farm net profit in real terms in S1 was 30% lower in 2013 than in 2004. Cash flow also showed a reduction in the S1 scenario of the order of 7% in nominal terms and 35% in real terms at the end of the 10-year period.

In the S2 scenario there was a net increase in farm profit in nominal terms in 2013 compared to 2004, but when adjusted for inflation net farm profit and cash flow reduced by approximately 23% and 29% respectively. In nominal terms, both S3 and S6 scenarios showed an increase of 14% and 6% respectively in net farm profit in 2013 compared to 2004, while the corresponding cash flow increases were 17% and 23% respectively. When inflation adjusted the net farm profit reduced by 20% and 26% for S3 and S6 respectively, while the corresponding reduction in cash flow was 18% and 14% respectively.

In nominal terms, both S4 and S7 scenarios showed an increase of 22% and 23% respectively in net farm profit in 2013 compared to 2004, while the corresponding cash flow increases were 25% and 38% respectively. When inflation adjusted the net farm profit reduced by 14% for both S4 and S7, while the corresponding reduction in cash flow was 13 and 3%. Even though there were increases in both net cash flow and net profit in nominal terms they were not sufficient to offset a decline in real terms. Both the S5 and S8 scenarios showed an increase of 23% and 26% respectively in net farm profit in 2013 compared to 2004 in nominal terms, while the corresponding cash flow increases were 26% and 41% respectively. When inflation adjusted the net farm profit reduced by 14% and 12% for S5 and S8 respectively, while the corresponding reduction in cash flow was 12 and 1%. Therefore the only investment and management strategies that approached sustaining real incomes over the period 2004 to 2013 were S7 and S8.

FAPRI-Ireland analysis on the impact of the Luxembourg CAP reform agreement on Irish agriculture has estimated that dairy farm number will reduce from 26,500 in 2003 to 18,000 in 2013 (Breen and Hennessey, 2003). This would result in average quota size increasing by about 50 percent from 200,900 litres to 295,100 litres. However, increases in quota size of this order will not be sufficient to compensate for the reduced prices over the period 2004 to 2013. Consequently, the industry also needs to consider options for improving cost competitiveness. The financial gain in achieving more cost efficient production on many Irish dairy farms are substantial and sustainable (Dillon *et al.*, 2003). Fingleton (2003), using data from the NFS 2002, showed that the costs of production varied from 13.6 cents/litre for producers in the lowest quintile to 23.3 cents/litre in the highest quintile, a difference in net margin per litre of 9.1 cents. A reasonable but immediate target would be a reduction in input costs by 10% on specialist dairy farms. Therefore pursuing measures that improve cost efficiency as well as increase in scale will be

necessary in maintaining incomes.

As part of the investment planning exercise the inclusion of risk factors is important for any dairy farming business. Information from an ordinary deterministic budgeting model may not be sufficient for future investment and management decisions on a farm, since the probability distribution of the outcome are usually nonnormal and skewed (Lien, 2003). Risk analysis indicated that the spread in farm net profit was much greater in the expanding scenarios than in the static options (S1). Farmers are generally risk adverse (Harrington and Niehaus, 1999; McQuinn, 2000) therefore they may be unwilling to under take this risk. Savoie *et al.*, (1985) stated that a risk adverse individual may be willing to forfeit some profit by choosing a technology, in order to reduce year to year variation in net returns. Therefore if dairy farmers were solely profit maximisers they would opt for the scenario that returned the highest profit for the farm but as they are not the option that is decided on will depend on their aversion to risk. The stochastically dominant scenario was dependent on the level of probability it was determined at, as at lower probabilities the static and REPS options were stochastically dominant while at the higher probabilities the expansion options were stochastically dominant. In basic terms this implies that more risk averse producers are likely prefer the static (S1) and REPS (S2) options over the more risky expansion options

Conclusion

Dairy farmers are currently facing a future of greater uncertainty due to the fundamental reforms for milk policy within the EU. FAPRI-Ireland analysis on the impact of the Luxembourg CAP reform projects that Irish milk price will fall to 22.9 cents/litre by 2010. In addition, the reforms have made retirement and exit from dairy farming more attractive as the decoupled compensation can be retained even if milk is not produced. For this reason, an elevated rate of restructuring is expected within the sector over the next few years. Dairy farmers that opt to remain static (S1) can expect a large reduction (~30% in real terms) in income. Farmers that expand using high cost conventional systems have an increased risk of financial loss. The fact that the CDFs for the different options crossed over means that the preferred option is dependent on the farmer's level of risk aversion. Static (S1) and REPS (S2) options are preferred by a more risk averse individual while less risk averse individuals are more likely to opt for expansion. Expansion by the use of low cost animal accommodation or the use of existing buildings (e.g. Conversion of beef cattle housing) greatly facilitates an increase in income and positive cash flow. However the level of restructuring in the industry may not be sufficient to facilitate the level of expansion in milk production at farm level required to offset the effect of reduced margins. Therefore as well as expansion using low cost animal accommodation there will be a requirement for more cost efficient milk production systems.

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CONFERENCE PAPER

E-BUSINESS DEVELOPMENTS IN THE IRISH AGRIBUSINESS INDUSTRY¹

P. Brandon, Dr. J. O'Connell, Dr. D.J. Ruane, Dr. P. Wims

Fifty five percent of Irish agribusinesses surveyed had a website. Whilst large multi-position businesses were the most likely to have a website (66%), 54% of the food businesses surveyed had a website. The reasons given by respondents for developing a website included; (1) to improve their promotions strategy (78%), and (2) as a key method for external communication with customers (69%). The use of e-business in the supply side was not considered as important, only 20% of respondents reported that e-procurement was an important issue. Seventy one percent gave "customers were not yet ready for e-business" as the main obstacle for continued e-business growth. The costs of developing a website and a lack of technological skills in many businesses were also seen as inhibiting factors (69% each). Eighty five percent of businesses without a website intended to develop one, while 72% believed that e-business would change the way their industry would do business in the next 5 – 7 years.

Key words: E-business, agribusiness, Ireland

Introduction and Background

In the last 10 years, Ireland has become internationally recognised as a hub of the "high-tech" sector and this has had a knock-on effect on indigenous companies from more traditional industries encouraging them to also become involved in e-business. The agribusiness industry has traditionally been one of the cornerstones of the Irish economy. For the purposes of this paper, agribusiness includes businesses involved in the manufacture and distribution of food products as well as businesses supplying inputs to the agricultural industry such as chemicals / pharmaceuticals, machinery and consultancy. This paper reports on an exploratory study carried out on the levels of e-business development and website adoption amongst Irish agribusinesses in 2002. The study concentrated on business to business transactions over the internet.

Mueller (2000) defined e-business as being business transactions conducted over electronic networks. This can involve material goods, immaterial services or may also mean rights and obligations. Payment can be made either online or offline through more traditional means of payment.

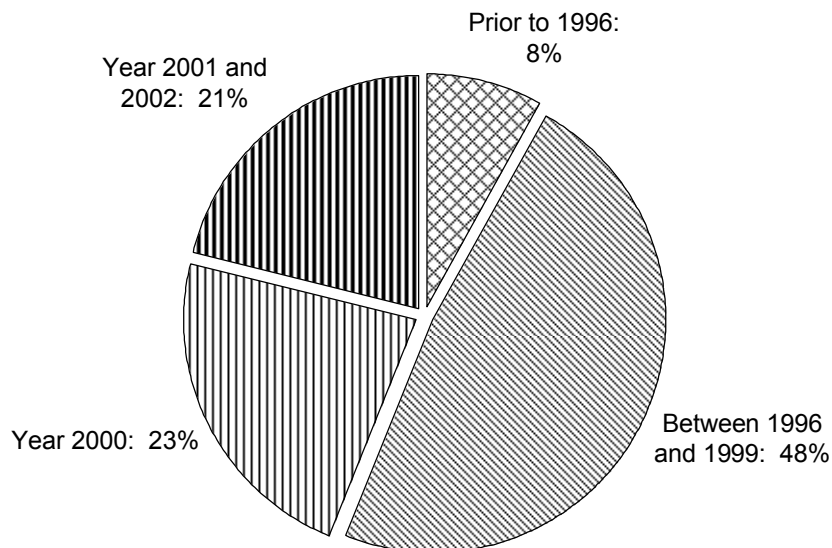
Two main areas of primary research were carried out. A comprehensive and detailed questionnaire was sent out to a random sample totalling 404 registered agribusinesses in the Republic of Ireland (as defined in the introduction). A response rate of 38% was achieved. It was hoped to develop the profile of a typical e-agribusiness company from the analysis of the questionnaires. The second part of the primary research involved in-depth case studies including interviews with senior management of five agribusinesses, chosen because of their clear commitment to e-business development.

1. This paper was presented at the EFITA Conference, 5-9 July 2003, Debrecen, Hungary and is repinted by permission of the organisers.

Web characteristics of Irish Agribusinesses

Fifty five percent of respondent agribusinesses had a website. This compares quite well to results from both from other Irish and international studies (Ehmke *et al* 2001, Clark *et al* 2001, Chambers of Commerce of Ireland 2001, Information Society Commission 2000). Almost half of these websites (48%) were developed in the period 1996 to 1999, the period when hype about the internet and e-business was at its height. *Figure 1.0* indicates when Irish companies developed their websites. Importantly it indicates that Irish agribusinesses have not halted their plans for website development despite the adverse publicity associated with e-business during the collapse of many of the dot-coms in 2000.

Figure 1. Period when Irish agribusiness went live.



Almost three quarters (72%) of businesses which did not have a website at the time of the survey intended to develop one (28% were developing one in 2002). However 60% of these businesses did not have a time-frame on their plans for website development.

Table 1 below shows that larger, more internationally focussed, multi-position and multi-sector businesses were the most likely Irish agribusinesses to be involved in e-business.

Features found on Websites

Sparkes and Thomas (2001) suggest that a good agribusiness website will contain information needed to facilitate a buying decision and will also have entertainment value. All Irish agribusiness websites contained basic information on the businesses themselves, the products they sold and services provided. Advanced features listed such as online ordering, business intranets, extranets and interactive facilities were present on 31% of websites. This is

Table 1. E-business Profile of the Irish Agribusiness Industry.

Characteristics of the business	% of businesses which had a website	Characteristics of the business	% of businesses which had a website
	%	Size of the business	%
Position in the supply chain that the business occupies			
Manufacturer	47	Small	39
Manufacturer/distributor	59	Medium	61
Multi position	66	Large	94
Sector that the business is involved in		Scope of the firms business interests	
Food industry	54	Local/regional	44
Animal feed	27	National only	49
Chemical/pharmaceutical	37	National and international	66

quite a high figure, given that only 19% of US agribusinesses had websites capable of advanced features (Henderson et al 2001)

Businesses which have had a website for longer were much more likely to have an advanced website. Indeed the association between when websites were first developed and the level of complexity of these websites was found to be significant at the 95% level (chi square significance). Seventy percent of websites developed prior to 1996 were advanced websites as were 38% of those developed between 1996 and 1999. Only 21% and 11% of websites developed in 2000 and 2001 / 2002 respectively were advanced websites. Three possible explanations for this trend are suggested:

1. Businesses initially develop a relatively simple website and continue to invest in their website over time until it becomes a more complex site. This would indicate that these businesses were satisfied with their websites and deemed it strategically important that they further develop their web presence. The experience of the businesses involved in the case studies supports this theory.
2. Businesses which have developed their websites since the dot-com collapse of 2000 have been reluctant to invest significantly in creating a more advanced site. They feel that while it is important to have a web presence, they would not gain anything extra from developing a more advanced website at this time.
3. Businesses which developed their websites prior to 2000 were likely to be the innovators and early adopters of the industry (Rogers 1983). These businesses are more adventurous by nature. Those which have developed websites since 2000 are the early and late majority categories and are more cautious and so less likely to invest in more advanced

technologies until the value of e-trading to their business is proven.

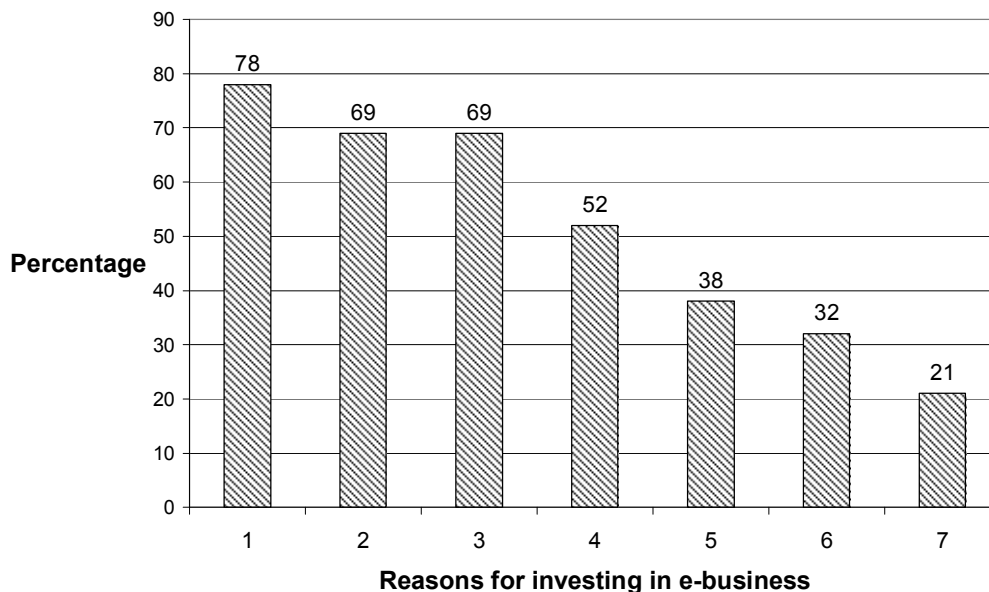
Reasons for investing in E-business

Agribusiness companies with websites were asked to identify their reasons for investing in e-business. The following were the three most important reasons for developing a website (full results shown in Figure 2).

1. More effective promotion of the business: Seventy eight percent of website respondents said that this was their key reason for investing in e-business.
2. Keep up with / ahead of competitors: Sixty nine percent deemed this to be a significant reason for website development.
3. Communication links to customers: Again 69% of respondents felt that this was a key factor in their decision to invest in e-business.

“Procurement of supplies”, “increased internal cost efficiencies” and “communication links to suppliers” were listed as the least important factors for investment in e-business.

Figure 2. Distribution of reasons for investment in e-business.



1. More effective promotion of the business
3. Communications links to customers
5. Communication to suppliers
7. Procurement of supplies.

2. Keep up with/ahead of competitors
4. Develop new markets
6. Increased internal cost efficiencies

It is worthy to note that while “communication links to customers” was one of the most important reasons for investing in e-business, improving communications on the supply side was not nearly as important. Irish agribusiness companies were mostly concerned with improving sales and after-sales service using e-business and were, as of yet, not worried about the possibilities for using e-business on their supply side.

Table 2. Key obstacles to e-business development for Irish Agribusinesses

Factors inhibiting the development of e-business	Type of Business	
	Website businesses	Non website businesses
	%	%
Customers not yet ready for e-business	72 ^b	60 ^b
Lack of in-house technical expertise	69 ^a	34 ^a
High initial development costs	69 ^a	19 ^a
Suppliers not yet ready for e-business	67 ^a	23 ^a
No online ordering system for Irish Agribusinesses	56 ^a	25 ^a
Lack of required trust to trade on the internet	55 ^a	13 ^a
Insufficient return on investment	53 ^b	39 ^b
Lack of advice on e-business strategies	54 ^a	13 ^a

a= significantly different at the 95% level (chi-square). Significance is calculated between the website businesses and for each individual obstacle.

b= not significantly different

Factors inhibiting the development of e-business

The key obstacle to e-business development for both businesses which had a website and those which did not have a website was “customers not yet ready for e-business”. Table 2 shows all of the key obstacles to e-business and outlines the differences in responses between website and non website businesses and whether each difference is significant at the 95% level (chi-square).

It is suggested that these results show that the non website businesses feel that there is not one major factor inhibiting the development of e-business in their industry. Instead there are a number of smaller factors, each of whose importance depends on how well prepared or suitable the individual business is for electronic business. This in turn will depend on the characteristics of that business in terms of size, scope, position in the supply chain, industry sector that the business is involved in, management, corporate strategy, and access to technology within the business.

Irish businesses were clearly worried about the opportunities to develop e-business links with their customers. Similarly, Clark et al (2000) reported in a study on New Zealand SMEs that respondents saw low customer use of e-business as a key barrier to e-business growth. High cost of computing and network technology and a limited knowledge of how to use these technologies were also major factors to the respondents in this survey.

Satisfaction with E-business and E-business Strategies for the Future

The case studies focused on the respondent's satisfaction with their website and their plans for further investment in e-business. The businesses involved in the case studies were a food business, an animal feeds manufacturer, an agricultural machinery distributor and retailer, an agricultural advisory service provider and a large multi-sector agribusiness. All of the five businesses from the case studies were satisfied with the performance of their websites but not extremely satisfied. They felt that since the website had not been set up with the expectation of carrying out a large volume of trade through the website, they could be satisfied with the performance of the website in terms of promotions, communications and information provision. The businesses attributed satisfaction to the number of "hits" on their website as well as from favourable comments from trading partners. None of them however were prepared to make an estimate for levels of business which could be attributed to the website, i.e. return on investment.

None of the case study businesses described their website as being central to their strategic plans. The businesses agreed that their investment in e-business in the coming years was likely to increase as the website begins to record more trade.

Table 3 (below) shows the responses from the questionnaire survey of both website and non website agribusinesses to six statements on the future of e-business in their industry.

Table 3. Future Direction of E-business in the Irish Agribusiness Industry

Statement of the future direction of e-business in the agricultural industry	Type of Business	
	Website businesses (N=86)	Non website businesses (N=69)
	agree with statement (%)	agree with statement (%)
E-business will change the way business is done in the agricultural industry in the next 5-7 years	73 ^b	71 ^b
E-business will reduce the role for local agricultural retailers in the next 5 – 7 years	27 ^b	25 ^b
E-business will improve ability to manage inventory levels in the next 5 – 7 years	48 ^a	60 ^a
Information on complex products is difficult to provide over the internet	37 ^b	42 ^b
E-procurement will become commonplace in the agricultural industry in the next 5 – 7 years	56 ^b	58 ^b
Distribution issues will limit sales of agricultural products over the internet	48 ^b	51 ^b

a= significantly different at the 95% level (chi-square). Significance is calculated between the website businesses and for each individual obstacle.

b= not significantly different

Table 3 shows that agribusiness companies felt that e-business would have an impact on their industry in 5 – 7 years while high numbers from each group

agreed with commentators such as Friochoil (2001), Lucking-Reiley and Spulber (2001) and Enterprise Ireland (2002) in their assessment that e-business would offer great opportunities to streamline inventory management. The responses of businesses to the statement on e-procurement is also worthy of note. Respondents were clearly confident that e-procurement would become much more important in the next 5 – 7 years, yet as noted earlier in this paper, e-procurement was the least important reason for investing in e-business. Other results also have shown that most businesses were concentrating on e-business on the sales side (communications with customers mostly) and not on the supply side. These two varying responses appear difficult to reconcile. However, it is suggested that businesses see e-procurement as the next step in the e-revolution. It is a natural progression to start concentrating on the supply side once the sales side has been managed. Therefore e-procurement is likely to become a more important issue for Irish agribusinesses in the future. These results are supported by the replies from businesses involved in the case studies. They felt that as with all aspects of business, development of e-business on the supply side would continue as more companies come online.

The case study businesses felt that extranet type features on websites would become more important in the future while one business was making a significant investment in mobile e-business (m-business).

Results from US studies show that US agribusinesses had similar points of view on the future of e-business in their industry when asked a list of similar questions (Henderson et al 2001, Ehmke et al 2001).

Conclusions

E-business is still very much in its infancy in the Irish agribusiness industry at present. While 55% of agribusinesses had a website, almost one quarter of these have only been online for the past year. This sheds light on a technology that is just beginning to find its foothold in the agribusiness industry. However some businesses stated that they had no interest in e-business at all and had no intention of ever developing a website. Forfas (2002) suggested that Irish businesses are now adopting a wait and see approach to the adoption of e-business. Many agribusinesses may be in this mode at present, given Irish national and wider international economic uncertainty.

Businesses have been concentrating on getting their websites up and running in the last few years and as of yet have not focussed on developing sales levels or procurement over the web. The website is being used in most businesses as a support tool covering most aspects of the business. It was seen by most of the website businesses as a key method of promotion. The website was also rapidly being seen as a very important communications tool, especially with customers. It affords a business a greater level of after sales service and allows them to be able to support customers in a much more proactive way.

It can be assumed then that if more and more businesses were to develop websites, then it would have a knock-on effect, forcing the more reluctant businesses to also become website businesses. If a business was confident that its customers were online and would use its website for communications, then

businesses could be assured that it is in their interests to build a website.

Most businesses stated that at present they were not interested in using their websites on the purchases side, be it to communicate with suppliers or to carry out e-procurement. However if businesses are not prepared to use their websites and e-business in this direction, then can they really expect other businesses (their customers) to carry out purchasing activity over the web. If a business wants to bring its customers online, it must set them an example, showing them the advantages of using the web to communicate with both suppliers and customers.

In conclusion, Irish agribusinesses are in the process of embracing the e-business culture. Those which have developed websites are strategically well positioned in the e-business world to gain the full benefits in terms of cost savings, information and communications from their websites. Of course many are still in the process of developing e-business in their business, an on-going process of which e-procurement is likely to be the next important phase. Other Irish agribusinesses however are in a less competitive position for e-business. Some appear to be hoping that their business will remain unaffected by e-business for as long as possible while others are at the early stages of developing strategic plans which will see them become part of the e-business world.

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REFEREED PAPER

RETURNS TO FARMLAND AND FARM LABOUR AND MANAGEMENT IN WESTERN CANADA

Marvin J. Painter

Canadian farm lobby groups have argued that without significant increases in farm subsidies to offset declining real commodity prices, many western Canadian farm families will be forced out of business. This paper measures the real returns to farm labour, management and capital for the period 1972 – 2003. The results indicate that western Canadian farm families have adapted by increasing farm size and diversifying their sources of income, especially to off-farm employment income. Farm families have done surprisingly well in the face of decreasing commodity prices.

Key Words: Farm Returns to Labour and Management, Farm Returns to Capital, Real Commodity Prices, Farm Family Income, Off-Farm Employment

Introduction

Many western Canadian farmers longingly look back at the high commodity prices of the 1970s and wonder if they will ever see those prices again. A common presentation made by Canadian farm lobby groups includes the 1973 price of wheat ¹ (\$161 per tonne for hard red spring and \$236 per tonne for durum) inflated to the present day using the consumer price index (CPI). For the year 2003, if wheat prices had increased by the average CPI each year since 1973, hard red spring wheat would have been priced at \$695 per tonne and durum at \$1,020 per tonne. Because actual prices in 2003 for hard red spring and durum were only \$202 and \$212 per tonne respectively, farm lobby groups have argued that farmers have significantly lost ground to others in the economy and that government should consider larger subsidies to make up the shortfall. But, comparing inflation adjusted grain prices can give a less than complete picture because it does not include technology changes (e.g. new seed varieties producing better yields), better use of fertilizers and chemicals, and larger farm sizes.

Nevertheless, it appears that farmer returns have been slipping. Farm family reliance on non-farm sources of income has been steadily rising. In 1971, 29%, 38%, and 30% of total farm family incomes for Alberta, Saskatchewan and Manitoba, respectively, came from the farm (see map). The remainder came from off-farm employment, investments (interest and dividends), and non-farm government transfers (old age security and Canada pension). By 2001, the farm as a source of income had decreased to 18%, 22%, and 22%, for Alberta, Saskatchewan and Manitoba, respectively. Off-farm employment has become the most common form of farm diversification in western Canada as real farm returns per hectare decreased.

In this paper, the returns to farmers' labour, management and capital are assessed over the period 1972 – 2003, for Alberta, Saskatchewan and Manitoba farmers. Three questions are addressed for the study period: 1) how

1. Source: Saskatchewan Agriculture, food and Rural Revitalization. The prices are Canadian wheat Board final prices, basis in store Saskatoon, Saskatchewan. All figures are reported in Canadian dollars.

Map of Canada



have returns to the average farmer's labour and management fared relative to the average provincial labour income and what has been the average return to farmers' invested capital relative to average stock and bond returns; 2) how have farmers adapted to falling real grain prices; and 3) if real commodity prices continue to decline, what will farms look like in the future?

Background

The 1970s were a high point for western Canadian agriculture returns. To illustrate the financial results in the farm sector since the early 1970s, gross farm receipts, net farm income, average farm size and total number of farmers, and average value of farm capital are compared for the three western Canadian provinces; Alberta, Saskatchewan and Manitoba.

Total gross farm receipts are comprised of crop, livestock and government program receipts. Table 1 shows that average real farm receipts were highest in Manitoba and lowest in Saskatchewan. Manitoba had the highest gross receipts for crops and programs and its average livestock receipts were almost as high as Alberta's. Saskatchewan had considerably lower livestock receipts, which contributed to its overall lowest total receipts. The average real growth figures ² indicate that, overall, Alberta is keeping pace with Manitoba, but only because its program receipts have been growing faster. Saskatchewan had

2. To calculate average real growth rates and average real dollar amounts, the Canadian Consumer Price Index was used to adjust for inflation over the study period.

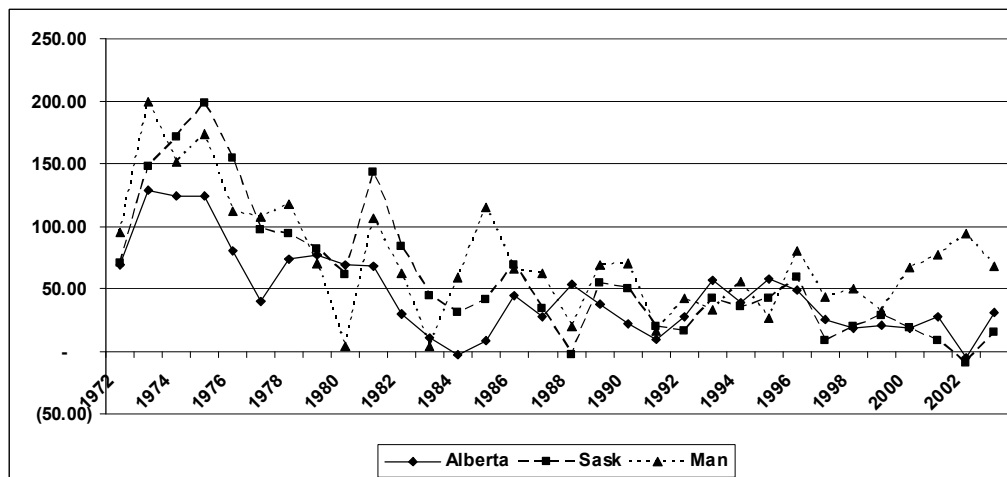
Table 1. Average farm cash receipts/hectare (2003 C\$) and average annual real growth in farm cash receipts/hectare (1972-2003)

	Average farm cash receipts/hectare (2003 C\$/hectare)			
	Crops	Livestock	Programs	Total
Alberta	130.49	169.15	25.52	325.16
Saskatchewan	169.89	53.72	27.07	250.68
Manitoba	209.18	166.28	32.58	408.04
	Average annual real growth in farm cash receipts/hectare (1972-2003)			
	Crops	Livestock	Programs	Total
Alberta	0.13%	1.13%	7.07%	1.38%
Saskatchewan	-1.06%	-0.48%	7.33%	0.08%
Manitoba	1.40%	1.16%	4.08%	1.14%

negative real growth in both crop and livestock receipts and only positive growth in program payments has kept overall real growth near zero percent. For all three provinces, overall real growth would be considerably smaller if not for the relatively high real growth in government program payments.

Net farm incomes³ have not fared as well as gross receipts. Figure 1 illustrates average real net farm income/hectare by province for the period 1972-2003. The long-term decline illustrates a common complaint from western Canadian farmers; farm expenses are rising consistently faster than

Figure 1: Real Net Farm Income/hectare (2003 C\$) 1972 – 2003



3. For Canadian farm financial data, Net Farm Income is calculated as follows:

Gross Farm Cash Receipts (including gov't program payments)

Less: Gross Cash Operating Expenses

Equals: Net Farm Cash Income

Less: Depreciation on Building and Equipment

Equals: Realized Net Farm Income

Less: Value of Inventory Changes (can be plus or minus, depending on whether inventories have increased (+) or decreased (-))

Equals: Net Farm Income. It is important to note that in the calculation of Net Farm Income, no allowance is made for farmer's labour and management efforts. Therefore, some of the Net Farm Income is attributable to farmer labour and management and some is return to capital invested.

farm receipts, resulting in an ever-decreasing profit per hectare. Each province achieved their highest real net income/hectare in the early 1970s; Alberta had \$129.18/hectare in 1973, Saskatchewan achieved \$198.64 in 1975, and Manitoba reached \$199.23 in 1973. The average real net income/hectare over the study period, in 2003 dollars, was \$45.70, \$60.19, and \$73.39 for Alberta, Saskatchewan and Manitoba, respectively. During the study period, both Alberta and Saskatchewan reached their lowest points in 2002, with net losses per hectare of \$4.85 and \$9.41, respectively.

As net farm income/hectare declined, the total number of western Canadian farmers also declined, as some farms could not survive financially. At the same time, as equipment and technology improved, successful farmers were able to manage increasingly larger farms. Figure 2 illustrates the growing

Figure 2: Average Farm Size (hectares) in Western Canada (1972 – 2003)

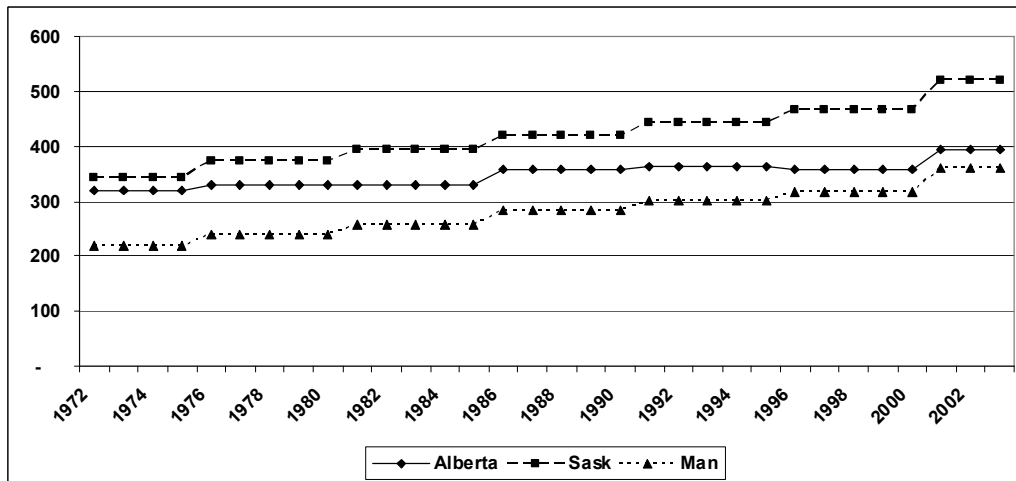
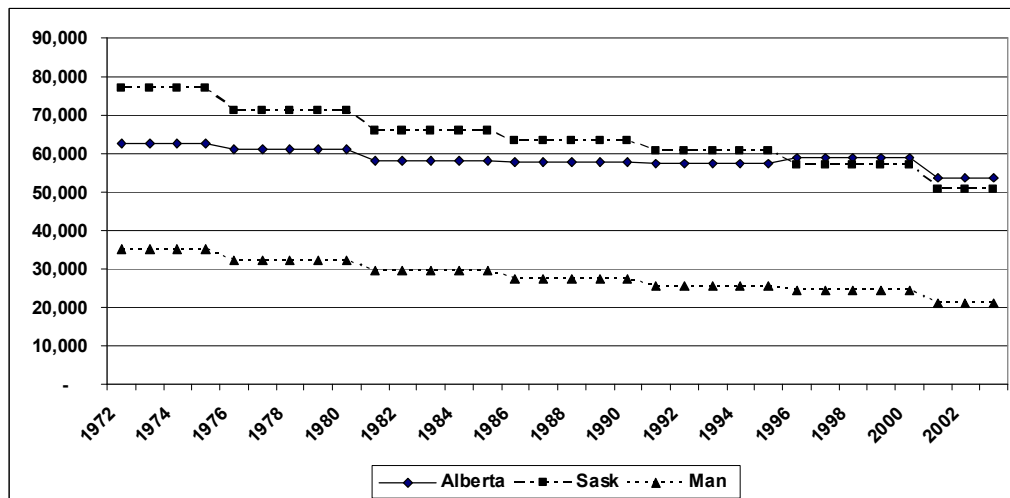


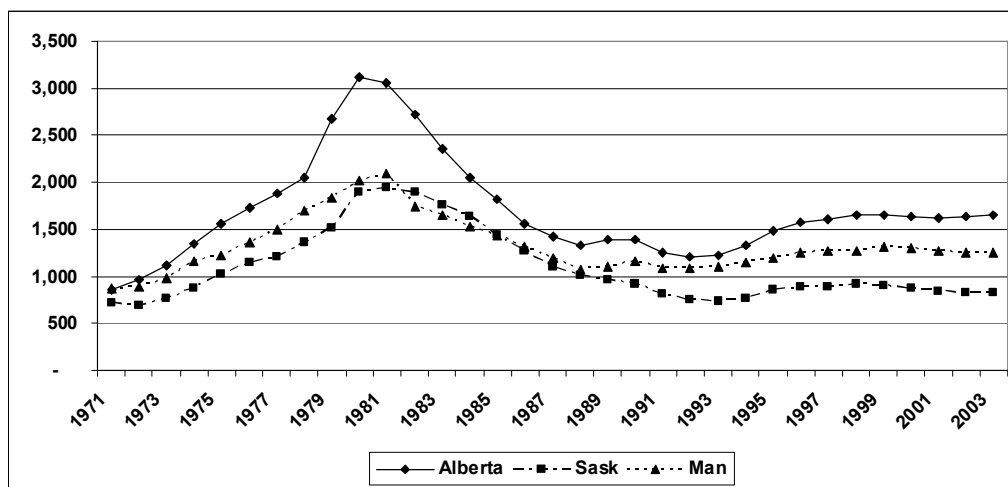
Figure 3: Total Number of Farmers in Western Canada (1972 – 2003)



average farm size, with Saskatchewan leading the way with the largest average farm size and the highest growth in average farm size. In 2003, Saskatchewan's average farm size was 519 hectares, while Alberta's and Manitoba's average farm sizes were 393 and 361 hectares, respectively. Figure 3 shows the declining number of farmers in each province, with Saskatchewan's farm population decreasing at the fastest rate.

Given the declining net farm income and growing farm size, what has been the impact on farmland values? Figure 4 illustrates real farmland values since

Figure 4. Average real value of farmland (2003 C\$/hectare). 1971-2003.



1971. High commodity prices during the 1970s pushed land values to their highest levels in the early 1980s. Since then, farmland values have decreased and leveled off. In both Alberta and Manitoba, real farmland values are higher than in the early 1970s; however, in Saskatchewan real farmland values are at the 1973 level. A full comparison of farmland values for the three provinces is reported in Painter (2004).

This snapshot of western Canadian farm financial returns over the past 30 years indicates an industry that is stagnant, at best, or in serious decline and unsustainable, at worst. Yet there are still over 125,000 farmers in western Canada (down from 175,000 in 1972). Do the aggregate and average statistics paint the wrong picture? The main objective of this study is to assess the ability of the average farm in Western Canada to produce a working income from labour and management (similar to a wage or salary income for off-farm employment) over the past 30 years, not on a per hectare basis but on a per farm basis, given that average farm size has been steadily increasing. Has the average farm labour and management income been able to keep pace with the average non-farm labour and management income? If not, how bad is it for the average western Canadian farm family and what can (and will) they do to improve their financial outlook?

Methodology and Data

Average returns to labour, management and capital (investment) are calculated for the study period 1972 – 2003, for Alberta, Saskatchewan and Manitoba farmers. Data for farm income and expenses, farmland values, average farm size and number of farmers for each of the provinces throughout the study period are derived from the provincial departments of agriculture; Alberta Agriculture, Food and Rural Development, Saskatchewan Agriculture and Food, and Manitoba Agriculture and Food⁴. The methodology applies the following steps.

Step 1: Calculate the Farmer Return on Investment (ROI)

The return on investment to farmland ownership is based on a standard crop share lease agreement which provides one-third of the gross receipts to the lessor (farmland owner) up to 1985, after which the crop share is reduced to one-quarter⁵. The reduction in crop share to the lessor was a market reaction to increasing input costs without corresponding increases in commodity prices (Painter, 2000). The lessor is then responsible for paying property taxes and depreciation on farm buildings. The crop share lease agreement represents the most common form of rental agreement in western Canada over the past 35 years.

The Net Crop Share/hectare (NCS) is calculated as follows:

$$NCS_t = CS_t - PT_t - BD_t \quad (1)$$

where,

NCS_t = net crop share/hectare in year t;
 CS_t = average lessor crop share/hectare in year t;
 PT_t = average property tax/hectare in year t; and
 BD_t = average building depreciation/hectare in year t.

Then,

$$ROI_t = \frac{NCS_t}{V_{t-1}} + \frac{V_t - V_{t-1}}{V_{t-1}} \quad (2)$$

where,

ROI_t = average return on farmland and buildings investment in year t;
 V_t, V_{t-1} = average value of farmland and buildings/hectare in year t and t-1;

$\frac{NCS_t}{V_{t-1}}$ = farmland owner's operating yield on farmland investment in year t; and

$\frac{V_t - V_{t-1}}{V_{t-1}}$ = farmland owner's capital gain yield in year t.

4. Other data sources that were used include Agriculture and Agri-Food Canada, Canada Grains Council, Canadian Wheat Board, Canadian Grain Commission, Canadian Transport Agency, Farm Credit Canada, and Saskatchewan Crop Insurance Corporation.

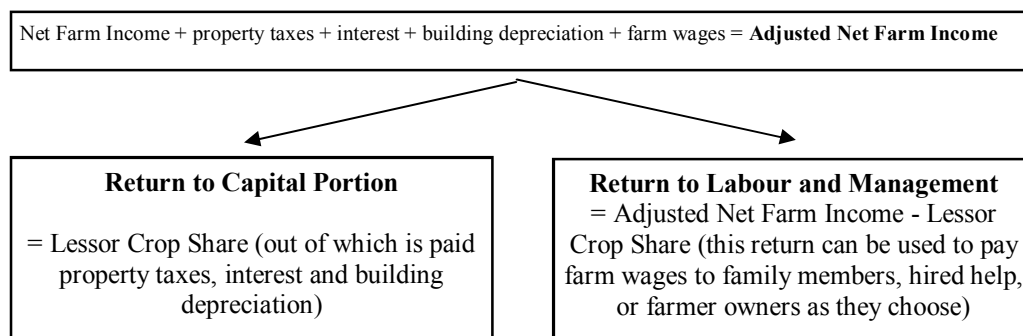
5. In the data set and calculations, a one-third crop share is used up to 1985 after which a one-quarter crop share is used for the remaining years.

Step 2: Calculate Residual Return to Farmer Labour and Management (L&M)

With this approach, the farmer return to labour and management is the residual left after all other expenses and returns to capital have been paid. In Canada, close to 50% of all farmland is leased. The farmer lessee must pay the lease payment just like any other expense, leaving the residual as the return to labour and management. In the case where the farmer owns the land, the farmer's opportunity cost is the lease revenue that could otherwise be obtained by leasing out the land, leaving the residual as the return to labour and management. For these reasons, this approach is considered reasonable for estimating the break-down between return to labour and management and return to farmland capital.

The residual return to labour and management is the net income left after paying all cash operating expenses and deducting the crop share paid to the lessor. The accounting for net farm income does not provide an indication of returns available to labour, management and capital. Adjustments need to be made to arrive at the total net income each year that is available to pay a return to labour and management and a return to capital. The expenses that need to be adjusted in the calculation (added back to arrive at adjusted net farm income) are; 1) land rent, building depreciation and interest expenses, as they are paid out of the return to capital, and 2) paid hired and family labour expenses (often paid to family members for tax purposes) as they are part of the return to labour and management. This explains why reported net farm incomes can be negative in some years even when returns to labour, management and capital are positive. Although there are other acceptable methods of disaggregating total farm returns into returns to labour, management and capital, this method has been employed in a number of cases: Painter and Schoney (1994), Painter (2000), Painter (2002) and Painter (2004).

The key is to determine the adjusted net income that is *available* to pay the two returns. In the calculation of net farm income, property taxes, interest on debt, building depreciation and paid hired and family labour⁶ have all been deducted as expenses. Therefore, these expenses need to be added back to arrive at annual adjusted net income, which can then be divided into return to capital and return to labour and management, as follows:



6. All paid hired and family labour must be added back in order to determine the total amount *available* to be paid to labour and management efforts. How the farm owners choose to pay out this portion is their choice, as they can pay themselves a wage, or a wage to other family members, or they can hire workers if the farm owners decide to engage in off-farm employment. Regardless of who it is paid to, it represents the return available to the labour and management effort.

Therefore, the calculation of the return to labour and management excludes all paid hired and family workers and any imputed value for unpaid family work and represents labour and management salaries available to the farm family. The net dollar return to labour and management per hectare is calculated for each year in the study period and for each province, as follows.

$$L\&M_t = ANFI_t - CS_t \quad (3)$$

where,
 $L\&M_t$ = dollar return available to pay all labour and management/hectare in year t;
 $ANFI_t$ = adjusted net farm income/hectare in year t; and
 CS_t = lessor crop share/hectare in year t.

Step 3: Calculate Total Return to Labour and Management for the Average Farm

As illustrated in figure 2, average farm size in Western Canada has been steadily increasing. The average dollar return to labour and management per hectare is multiplied by the average number of hectares per farm to arrive at the return to labour and management for the average farm family. The calculations are as follows.

$$TR_t = L\&M_t \times AFH_t \quad (4)$$

where,
 TR_t = the total dollar return to labour and management for the average farm family in year t;
 $L\&M_t$ = dollar return available to pay all labour and management/hectare in year t;
 AFH_t = average number of hectares per farm in year t.

Step 4: Compare Farm Family Labour and Management Returns to Average Provincial Labour Incomes

Average farm family returns to labour and management (farmers' wages and salaries) are compared to average wage and salary incomes for the whole province. This comparison is meant to gauge how farm families have fared relative to non-farm families regarding their labour and management efforts. Average provincial wage and salary incomes for each province over the study period are derived from Statistics Canada: Canadian Economic Observer (2003).

Average percentage yields on farm capital investment are compared to average stock and bond yields over the study period to determine how farmland has fared as an investment, relative to financial assets. Canadian bond yields are derived from Canadian Economic Observer (2003) and average stock market yields are derived from Morgan Stanley Capital International (2003).

Step 5: Compare Average Total Farm Family Income with Average Total Provincial Family Income

This comparison is meant to indicate how farm families have fared

economically, relative to the provincial average family. Hence, total income from all sources is included, as opposed to just labour and management income. This comparison assists in explaining how farm families have adapted to declining farm incomes.

Step 6: Average Farm Size in the Future

A projection of future average farm size and the number of farmers in each province is made, assuming that commodity prices continue at the same real growth as in the past (negative growth) and farmers wish to maintain their 2003 income levels.

Results and Analysis

Return on Farmland Investment

Table 2 illustrates the average farmland return on investment for each province over the study period. Alberta had the lowest operating yield because it has the largest proportion of land in hay and pasture while it had the highest capital gain yield, which illustrates the fastest rising land prices for the three provinces. The reasons for Alberta's rising land values are discussed in Painter (2004). The average Canadian inflation rate over the study period was 5.1%, which implies average real investment returns of 3.1%, 4.0%, and 4.7%, for Alberta, Saskatchewan and Manitoba, respectively. The average nominal farm debt rate over the study period was 9.5%, which implies that capital returns were very close to average debt rates. Due to low operating yields, average

Table 2. Average annual nominal return on farmland investment (1972-2003)

	Operating Yield	Capital Gain Yield	Total Yield
Alberta	1.5%	6.9%	8.4%
Saskatchewan	3.8%	5.7%	9.3%
Manitoba	3.8%	6.3%	10.0%

debt ratios for the period have averaged between 15% and 25%.

Table 3 illustrates average real dollar returns to farmland investment per hectare. The 2003 land values for each province are somewhat consistent with total capital returns, with Alberta having the highest returns and land values, while Saskatchewan is the lowest in both categories.

Table 3. Average annual real returns to farmland investment per hectare (2003 C\$) 1972-2003

	Net crop share (2003 C\$)	Capital gain (2003 C\$)	Total capital return (2003 C\$)	2003 land value/hectare C\$
Alberta	24.03	113.15	137.18	1 645
Saskatchewan	38.16	61.45	99.61	820
Manitoba	46.65	79.56	126.51	1257

Returns to Labour and Management per Hectare

Table 4 illustrates the average returns to farm labour and management per hectare and average real growth in those returns, over the study period. In all three provinces, average real growth is very low, especially in Saskatchewan. The reason for Saskatchewan's negative real growth can be explained with the help of Table 1. In both Alberta and Manitoba, farm families have diversified into value-added livestock production much more so than in Saskatchewan.

Table 4. Average annual real returns to labour and management per hectare (2003 C\$)(1972-2003)

	Labour and management/ hectare	Average real growth
Alberta	75.04	0.0%
Saskatchewan	59.11	-1.5%
Manitoba	85.68	0.3%

Alberta has focused more on cattle while Manitoba more on hogs. In both cases, the value-added livestock activity has produced returns to labour and management efforts. However, it has likely also meant more of farmers' time spent on labour and management in Alberta and Manitoba.

Total Returns to the Average Farm

Table 5 indicates how the average farm family has fared in each province over the study period. Figure 2 illustrates that in all three provinces average

Table 5. Average annual total returns to the farm family (2003 C\$)

	Labour and management	Net crop share	Capital gain	Total return
Alberta	25 955	8 166	37 696	71 817
Saskatchewan	23 407	15 372	22 504	62 283
Manitoba	23 720	12 856	19 675	56 251

farm size has been steadily increasing. Average annual growth in farm size has been 0.7%, 1.4%, and 1.6%, for Alberta, Saskatchewan and Manitoba, respectively. Changing technologies associated with equipment, fertilizers, chemicals, and seed varieties have allowed farmers to be increasingly more productive over the past 30 years, which has resulted in larger family farms.

Table 6 illustrates the average growth in labour and management income for the average farm family, showing that part of the growth is due to growth in labour and management returns per hectare and part is due to growth in average farm size. Alberta and Manitoba have maintained positive real growth in labour and management income for the average farm family mainly by growing farm size. They have realized 0.0% to 0.3% real growth in labour and management income per hectare even as real commodity prices have been falling. This is likely due to their involvement in value-added livestock production. Manitoba has had the largest average growth in farm size which

Table 6. Average annual real growth in farm family labour and management income (1972-2003)

	Labour and management / hectare	Average farm size	Farm labour and management
Alberta	0.0%	0.7%	0.7%
Saskatchewan	-1.5%	1.4%	-0.2%
Manitoba	0.3%	1.6%	1.9%

has led to significantly higher average growth in labour and management income for the average farm family in that province. Saskatchewan, due to relying most heavily on raw grain commodity production, has seen a significant decline in real labour and management income per hectare (-1.5% per year). Because Saskatchewan has also had a significant increase in average farm size, they have been able to maintain annual real growth in average labour and management income at a slightly negative rate (-0.2%). However, that also implies that, given Saskatchewan's reliance on grain commodities, they have not increased average farm size at a rate sufficient to keep real labour and management income from falling, much less keeping up to the growth in the other two provinces.

Compare Farm Family Labour and Management Income to Average Provincial Labour Incomes

Table 7 compares average farm family labour and management income

Table 7. Comparisons of average farm family labour and management income to average provincial family wage and salary income (2003 C\$) 1972-2003

	Average farm labour and management income	Average provincial wage and salary income
Alberta	25 955	35 742
Saskatchewan	23 407	26 615
Manitoba	23 720	30 949

with average provincial wage and salary incomes over the study period. Average farm labour and management income is similar between provinces, with Alberta being slightly higher on average. However, farm labour and management income is lower than average provincial wage and salary incomes in all three provinces, with Saskatchewan farm families coming closest to non-farm incomes in that province. Average farm labour and management income as a percentage of average provincial wage and salary income is 73%, 88%, and 78%, for Alberta, Saskatchewan and Manitoba, respectively.

Figures 5, 6, and 7 show the trends in both farm labour and management income and average provincial wage and salary income over the study period. In Manitoba, farm labour and management income is growing faster than non-farm incomes (although average real farm labour and management income over the period is lower than non-farm incomes, as shown in Table 7). However, in both Alberta and Saskatchewan, real growth in farm labour and management income has not kept up to average wage and salary income. This

Figure 5: Average Farm Labour and Management Income and Average Provincial Wage and Salary Income for Alberta (2003 C\$) 1972 - 2003

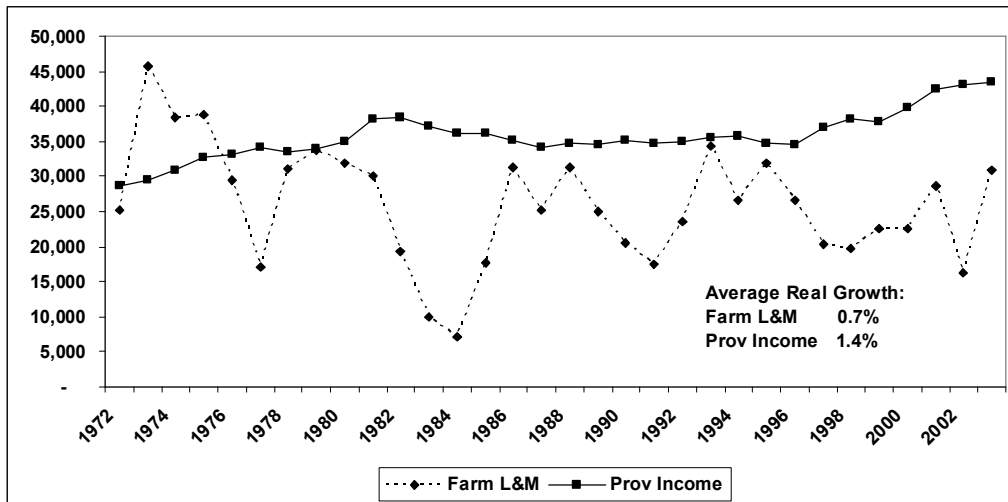
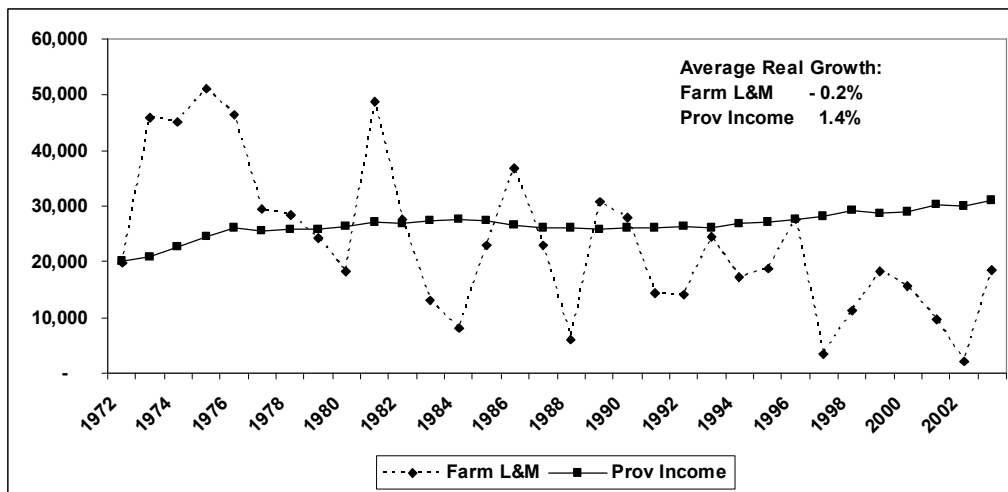
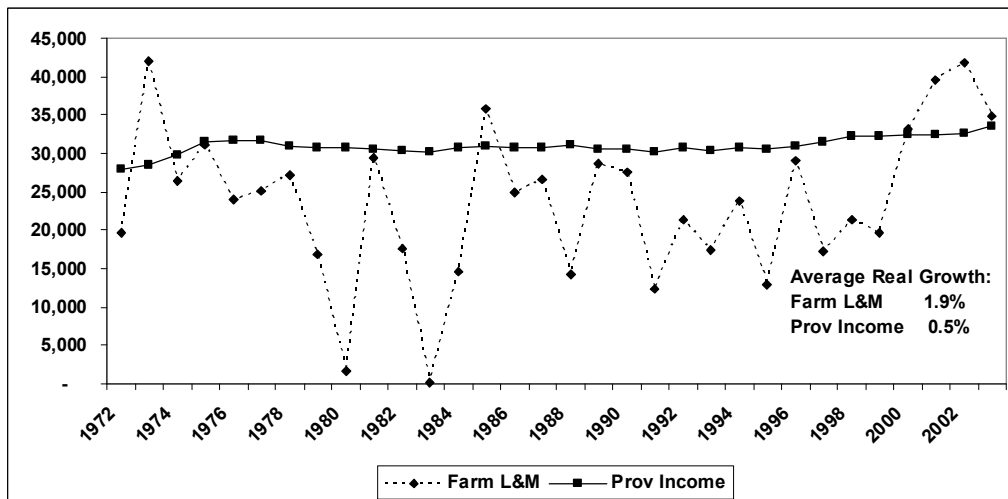


Figure 6: Average Farm Labour and Management Income and Average Provincial Wage and Salary Income for Saskatchewan (2003 C\$) 1972 - 2003



implies that, if Alberta and Saskatchewan farm labour and management incomes are to keep pace with non-farm incomes, farmers in those provinces will have to either increase their labour and management income earned per hectare (this will be difficult, especially in Saskatchewan, if real commodity prices continue to decline) or increase the average number of hectares per family farm at a faster rate than in the past. For example, in Saskatchewan, average non-farm wage and salary incomes have experienced average real growth of 1.4% per year from 1972 to 2003. For average farm family labour and management income to have kept pace, and assuming that farmers could not have improved average labour and management income per hectare, average Saskatchewan farm size would have had to increase by an average

Figure 7: Average Farm Labour and Management Income and Average Provincial Wage and Salary Income for Manitoba (2003 C\$) 1



rate of 2.9% per year (actual growth in average farm size was 1.4% per year). That would have made the average farm size in Saskatchewan 830 hectares in 2003 instead of the actual average 519 hectares, with 30,000 farms instead of 50,000. A similar calculation for Alberta and Manitoba would have Alberta average farm size at 492 hectares instead of the actual average of 393 hectares, and Manitoba could have grown to as little as 234 hectares instead of 361.

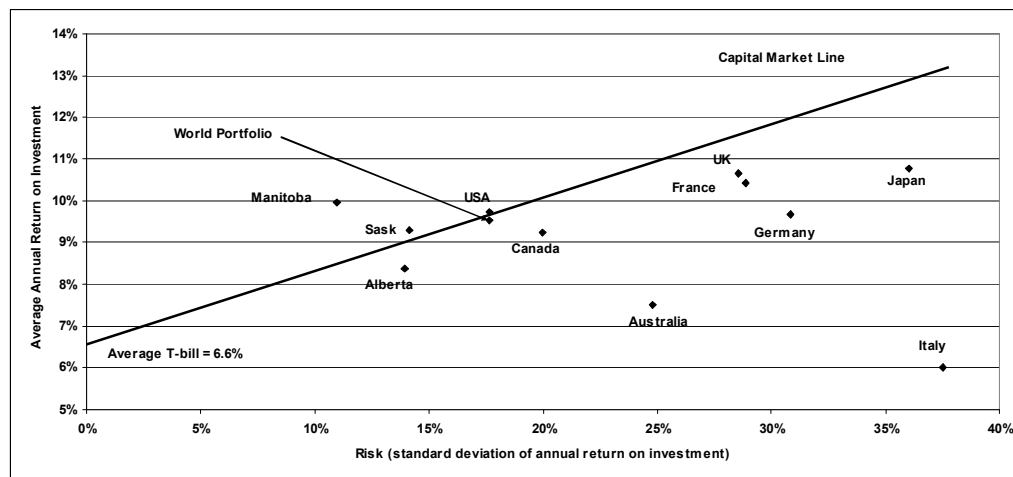
Compare Average Farm Capital Yields with Average Financial Asset Yields

Table 8. Average nominal investment yields for farmland, bonds and stocks (1972-2003)

Farmland	Operating yield	Capital gain yield	Total yield
Alberta	1.5%	6.9%	8.4%
Saskatchewan	3.8%	5.7%	9.3%
Manitoba	3.8%	6.3%	10.0%
Bonds			Average yield
Canada 3-mth T-bills			6.58%
Canada long bonds			7.85%
Stock Markets	Dividend yield	Capital gain yield	Total yield
Australia	3.11%	4.46%	7.5%
Canada	2.74%	6.51%	9.24%
France	2.72%	7.69%	10.42%
Germany	2.24%	7.48%	9.68%
Italy	1.96%	4.09%	6.01%
Japan	1.42%	9.43%	10.77%
UK	3.73%	7.03%	10.65%
USA	2.61%	7.15%	9.74%
World	2.43%	7.12%	9.53%

Table 8 shows that farmland investment yields have been very similar to average stock and bond yields over the study period. Average farmland operating yields have been very close to average dividend yields, with farmland operating yields being slightly higher, especially for Saskatchewan and Manitoba farmland. Figure 8 shows a comparison of investment yields

Figure 8: Risk-Return Comparison for Western Canadian Farmland and Stock Markets (1972 – 2003)



and risk for western Canadian farmland and international stock markets⁷. Risk is measured by the standard deviation of total annual yields (standard deviation of the annual return on investment) over the study period. On a risk-return basis, western Canadian farmland is very competitive with financial asset investments.

Most of the farmland and stock yields are in the range of 8% to 10%, while Canada bond yields have been slightly lower at 7% to 8%. This implies that farmland investment yields have been large enough to allow farmers to finance expansion, provided that average debt ratios⁸ do not exceed farmland operating yields as a percentage of total farmland yields (the farmland operating yield is the cash portion of the total farmland yield which can be used to make debt payments). However, the long-term farmland yields do not tell the whole story. While the average farmland yields from 1972 to 2003 appear to be reasonable, the recent short-term yields are not as good. For the period 1990 to 2003, average farmland investment yields for Alberta, Saskatchewan and Manitoba, respectively, have been as follows: operating yields of 1.1%, 3.1%, and 3.3%; capital gain yields of 3.5%, 1.1%, and 3.2%; and total yields of 4.6%, 4.1%, and 6.5%. During this time period, the average farm debt interest rate has been 7.5%, which means it has been slightly more difficult for farmers to finance expansion since 1990.

7. International stock market yields are available from Morgan Stanley Capital International.

8. This refers to the farmland debt ratio, which is farmland debt divided by the cost of the farmland. In other words, it is the portion of the total farmland cost that is financed with debt.

Compare Average Total Farm Income to Average Provincial Family Income

Table 9 compares average family income (all families) with average farm

Table 9. Comparison of average total family farm income (with % from farm sources) and average provincial family income (2003 C\$) 1971 - 2001

Year	1971	1981	1991	2001
			Alberta	
Farm families	33 608	63 911	57 112	71 644
% farm source	29%	30%	11%	18%
All families	47 678	70 365	68 156	76 526
			Saskatchewan	
Farm families	28 347	59 075	52 969	58 730
% farm source	38%	49%	22%	22%
All families	36 814	58 899	57 716	61 098
			Manitoba	
Farm families	27 810	48 177	50 440	53 827
% farm source	30%	37%	22%	22%
All families	43 499	56 624	60 012	62 242

family income, for each province. In 1971, average total farm family income was 70%, 77% and 64% of provincial average family income for Alberta, Saskatchewan and Manitoba, respectively. By 2001, average farm family income as a % of average provincial family income had risen to 94%, 96% and 85%, for Alberta, Saskatchewan and Manitoba, respectively. This was accomplished by farm families even as the labour and management returns from the farm (especially in Alberta and Saskatchewan) were declining relative to overall labour and management returns in the province. Farm families were able to narrow the income gap by increasing average farm size and, most importantly, by increasing off-farm sources of income.

Future Average Farm Size

If farmers in western Canada are going to keep up with average labour and management incomes, what will have to happen to average farm size in the future? From the foregoing analysis, it is clear that farms will have to continue to increase in size and at a faster rate than in the past if commodity prices continue to experience negative real growth. Because of the competitive nature of commodity markets, it is likely that grain prices and real labour and management returns per hectare will continue to fall even as new technologies make farmers more efficient. Table 10 shows what will happen to average farm size and the number of farmers over the next 20 years in each province under the following conditions

:

1. cropping, livestock and program proportions continue at past averages;
2. real commodity prices continue to fall;
3. real growth in farm labour and management income per hectare continues at past average growth rates;

4. average real growth in farm family labour and management income will be 1% per year (assumed to be keeping pace with non-farm wage and salary incomes).

Table 10. Average Farm Size (hectares) and the Number of Farmers in Western Canada

Average farm size (ha)	1972	2003	2023
Alberta	320	393	479
Saskatchewan	342	519	857
Manitoba	220	361	418
Number of farmers	1972	2003	2023
Alberta	62 703	53 652	43 983
Saskatchewan	76 990	50 598	30 677
Manitoba	35 006	21 071	18 162

Under these conditions, Saskatchewan will have the largest expected increase in average farm size over the next 20 years, mainly because of its continued reliance on producing raw grain commodities which are negatively impacted by falling real commodity prices. Along with the large increase in average Saskatchewan farm size is the large decrease in number of farmers. The depopulation of rural areas will continue and many communities will see closures of health and education facilities as well as other services. Alberta and Manitoba will also see a declining number of farms but at a slower rate. If they continue to grow their value-added industries they may be able to slow the decline even further.

Conclusions

The first question addressed in this paper is whether western Canadian farm labour and management incomes and capital returns have kept pace with average wage and salary incomes and financial market investment returns. The comparison of farm family labour and management incomes to average provincial wage and salary incomes indicates that farm families in Alberta and Saskatchewan have lost some ground. However, it is not nearly as severe as some farm lobby groups would have us believe. In Alberta and Saskatchewan, even though farm family labour and management incomes have not kept up to the average wage and salary incomes, Alberta did experience positive real growth and Saskatchewan, with slightly negative real growth, basically was able to keep up with inflation. Of course, if nothing happens to change this trend, the gap will continue to grow, making farm labour and management returns less and less attractive. In Manitoba, farm family labour and management incomes, while lower than average provincial wage and salary

incomes on average over the study period, have been growing faster and have recently surpassed the average wage and salary incomes for the province.

The comparison of returns on farm capital with returns on financial assets shows that farmland investment has been very competitive over the study period of 1971 – 2003. However, farmland investment returns have slipped in the last decade (1990 – 2003) to the 4.5% to 6.5% range. These rates of return are still high enough (just) to cover current farmland debt rates, which are approximately 5% however, they are lower than most stock market yields. For example, for the period 1990 – 2003, the average stock market yield in Canada was 7.34%, the United States was 10.39%, and the World portfolio was 6.04%. It is difficult to say whether farmland investment yields will increase in the future, especially if real commodity prices continue to decline. Increasing average farm size may produce further economies of scale, which could produce higher farmland investment yields, but it is also possible that farm operators will capture those efficiencies, improving farm labour and management returns instead.

The second question is about how farm families have adapted to falling commodity prices. The most significant change has been an increase in off-farm employment. Alberta farm families increased their reliance on non-farm income sources from 71% in 1971 to 82% in 2001, Saskatchewan increased from 62% to 78% and Manitoba increased from 70% to 82%. This translated into farm families significantly narrowing the gap in family incomes between 1971 and 2001. In 1971 the average farm family income was lower than the provincial average family income by 30%, 23% and 36%, for Alberta, Saskatchewan and Manitoba, respectively. By 2001, the gap had decreased to 6%, 4% and 15%, for Alberta, Saskatchewan and Manitoba, respectively.

Western Canadian farm families have also adapted to falling commodity prices by increasing farm size. The economies of scale achieved from larger farm size was not enough to completely offset the low to negative growth in farm labour and management returns per hectare. It is difficult to say whether farmers would have increased farm size faster, had they been able. The yields on farmland ownership have been large enough to finance farm growth, but only with average debt ratios up to 25%. Hence, farm size can only grow as fast as a farmer's equity grows, if the expanding farmer is intent on owning the farmland. The solution to this potential financing problem is leasing, which has been steadily increasing over the study period. But, there must be farmland available for sale or lease before a farmer can expand, which means another limitation on farm size growth is the number of farm operators leaving the industry. In 1971, the median age of farm operators in Saskatchewan was 49 years, and in 2001 the median age was 50 years. Therefore, it is uncertain whether farmland will be turning any faster in the next 30 years than it did in the last 30.

This brings us to the third question; what will farms look like in the future? The foregoing analysis clearly points to larger farms as farm families take advantage of their ability to farm more hectares (technology) and the higher family income attained from larger farms. However, the previously noted limitations on growth in farm size may hamper this strategy, especially in Saskatchewan. The other option for farm families to increase their incomes,

besides more off-farm employment, is to do more of what Alberta and Manitoba farmers have been doing; increase their involvement in value-added activities such as livestock production. To the extent that this can be done, farm size need not increase as fast and hence, rural depopulation could slow or possibly even plateau.

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Biographical Note

Marvin J. Painter is Associate Professor of Management and Marketing, University of Saskatchewan, Canada. He teaches agribusiness management in the MBA program as well as to farmers and others in the agribusiness industry. Dr. Painter has been involved in consulting projects that include farmland and business valuation, agricultural business plans and feasibility studies.

REFEREED PAPER

BENCHMARKING FARM ENTERPRISES

Franks, J. R and Haverty, M. J. P.

Traditional benchmarking involves drawing like-with-like comparisons between farm and farm enterprise performance and industry standards (horizontal benchmarking). Horizontal benchmarking adds additional value if it allows the benchmarker to identify the processes which underlie the industry standards (the benchmarks). Vertical benchmarking involves drawing comparisons with businesses along the food supply chain - where comparing relative financial performance rather than processes is more important. More farmers would benchmark if the likelihood of a positive payback to the costs incurred was increased. This may be achieved by supporting fewer, larger, more robust enterprise surveys which report a wider range of descriptive and process data, and by devising and reporting a measure of financial performance that can be directly compared between firms at different levels in the food supply chain.

(Key words: benchmark, business competitiveness, comparative analysis, key performance indicators, processes, industry standards).

Introduction

Traditional benchmarking involves making like-with-like comparisons with other farm businesses and learning from the lessons that these comparisons throw up (Ashworth, 2002; Spendolini, 1992). The comparison generally is made on a specific type of measure that provides a numerical measure of performance (Gray, 2001). Benchmarking is, therefore, about borrowing good ideas from others about how to improve (Brown, 1995). Whilst this is certainly not a radical innovation, there is evidence from a survey by the Food Supply Centre of 1,200 farmers across England and Wales that only 9% of farmers benchmark. Of this 9%, 42% described the main benefits as "helping better to understand costs" and 15% said it had helped them achieve lower costs (Farmers Weekly, 2003).

The Policy Commission for Food and Farming (2002) urged farmers to appraise and reappraise techniques and management practices which may increase economic efficiency (p. 26); citing evidence in *inter alia* Barr *et al.*, (2001), Wilson and Robertson (2001); Sheppard, (2001); Franks *et al.*, (2001) and Renwick (2001) that, "different farmers are getting very different results from the same quantity of inputs" (p. 26). In the Commission's view,

"This very wide spread of performance cannot entirely be explained by differences in climate or land quality. (p. 26)."

The Commission suggested that farming should make more use of benchmarking to help identify excessive costs and inefficiencies and thereby solidify and stabilise the financial structure of farms and increase business competitiveness. It noted that,

"Many businesses up and down the food chain are not measuring the costs

1. The work presented in this paper is based on research funded by the Farmers Fund. Their financial support is gratefully acknowledged.

of their operations and their inputs, and do not understand how their national and international competitors go about managing their costs. All businesses need to assess how they are operating compared to the leading businesses in their sector (p 26),"

It recommends benchmark

"with the best at home and abroad to gain a deeper understanding of costs and efficiencies," (p. 26-27)."

It may also have added that comparisons could also be made with similar practices used in other industries (Anderson *et al.*, 1999).

Perhaps the relatively low use of benchmarking suggests possible misconceptions about how to benchmark. McGonagle (1993) believes that many businessmen and farmers consider benchmarking to be the domain of only the largest firms. This incorrect notion may have arisen because of the myths that surround benchmarking, summarised by Boykin (1996) as:

- Benchmarking has to be expensive.
- Benchmarking should only be performed by experts.
- Benchmarking has to be complicated.
- Only industry leaders make acceptable benchmarking partners.

While none of the above need be the case, benchmarking can be expected to add at least some costs, so the priority to encourage more farmers to benchmark must be to increase the likelihood of a positive return from their investments.

The majority of the farmers surveyed by the Food Supply Chain (86%) said they required more information or help to get started benchmarking (Farmers Guardian, 2003). This is the motivation for this paper, which presents the authors' views on how to benchmark and how to get more value from benchmarking - which in our view is the necessary precursor to the more widespread use of benchmarking. The next section sets out a step-by-step guide to benchmarking thereby helping to meet farmers' needs as expressed in the survey. This is followed by a review of options for increasing the use of benchmarking by farmers. The conclusion highlights the need for a financial performance benchmark that can be applied to all businesses along the food supply chain.

How to benchmark

Benchmarking seeks to compare data for one business – in production, economic or environmental terms - to average performance achieved by other similar businesses to establish targets, identify priorities, devise improved processes, and implement improvement programmes based on the results (Waterfield, 2002; Reed, 1998; Camp, 1989). There are a large number of definitions of benchmarking, but most require the benchmarker to; (1) compare like-with-like, (2) compare against average and best-in-class industry standards (the benchmark), and (3) identify the processes underpinning

performance in the comparator group. Benchmarking is, therefore, the careful identification of performance indicators that are of particular importance to a selected enterprise / individual farm (key performance indicators) and their comparison against up-to-date industry standards calculated from a survey of a representative sample of enterprises / farms.

Table 1 shows the eleven steps in benchmarking grouped into four sections (Franks and Haverty, 2004). Section 1 involves selecting the aspects of the farm enterprise to measure – so-called key performance indicators (KPI). Selected KPI generally measure enterprise performance and the processes that underlie that performance (but could be selected to measure other goals and aspirations, (Byles, 2003)).

Table 1. Eleven steps to effective benchmarking.

SECTION 1: THE ENTERPRISE AND ITS BUSINESS ENVIRONMENT – SELECTING WHAT TO MEASURE.

- 1 Identify enterprise generic KPI.
- 2 Select enterprise specific KPI, these are KPI that apply across all similar enterprises.
- 3 Select farm specific KPI, measures that reflect the particular constraints applying to your own farm enterprise.

SECTION 2: MAKING THE COMPARISONS – IDENTIFY THE PERFORMANCE GAPS.

- 4 Select the most appropriate comparative survey to use as the industry standards against which to benchmark your farm.
- 5 Use the same methodology to calculate KPI for your farm as that used by the survey to calculate the industry standard.
- 6 Identify performance gaps by comparing own KPI against the average performance of the entire sample, and against selected sub-samples, of survey participants.

SECTION 3: ANALYSE PERFORMANCE AND DRAW-UP POSSIBLE ACTION PLANS.

- 7 Investigate the reasons causing the performance gaps in enterprise generic, enterprise specific and farm specific KPI.
- 8 Consult “best practice” literature to identify strategies for improving enterprise performance.

SECTION 4: COST-OUT, SELECT AND IMPLEMENT AN ACTION PLAN.

- 9 Assess the impact of any proposed plan to improve enterprise performance on the whole farm profitability.
- 10 Formally estimate the profitability of a proposed change.
- 11 Implement the action plan.

KPI measure the productivity of a specific resource in physical (e.g. litre/ha) or financial terms (£/ha). Enterprise generic KPI reflect the impact of underlying economic pressure across all enterprises. Enterprise specific KPI reflect the biological underpinning of the specified enterprise. Farm specific KPI reflect the strengths and weaknesses of the benchmarker’s individual business, personal and farming circumstances; they should measure performance of those inputs that are the greatest constraints on enterprise performance, so farm specific KPI are likely to vary between farms. Some KPI could fall into more than one of these categories, what is important is selecting the KPI rather than debating what category it should be allocated to.

KPI are usually quantitative measures of performance and of technical and managerial efficiency. But KPI can also be descriptive or qualitative, for example, identifying the type of milking parlour, breed of animal and market outlets. Descriptive KPI offer insights into the predominant technology and management practices employed on the farms in any survey sample or sub-sample. It is the richness of these measures that often determines the usefulness of benchmarking in identifying underlying processes. There is some benefit in categorising KPI into three types (section 1 of Table 1).

The first three steps involve identifying which KPI to compare. The first step involves selecting enterprise generic KPI; these KPI reflect the impact on an enterprise of the competitive forces that act on the agricultural sector. For example, changes in farm and enterprise size, the number of enterprises, percentage self-sufficiency and import penetration, structure of the food chain, enterprise support mechanisms and trends in consumer demand.

Potential dangers exist when benchmarking is used only to focus on the 'internal' competencies (e.g. costs) of a farm vis-à-vis similar farms as this may result in "blindness" to change in customer requirements (which are more 'external' in outlook). The use of enterprise generic KPI is designed in part to help avoid this. For example, the choice of marketing strategy has become more important over the last decade and changes introduced under the Mid Term Review will make marketing decisions even more important. If benchmarking suggests that the farmer needs to focus on the food and value change beyond the farm-gate, then this is important information that has added a distinctive form of competitive advantage.

When KPI measure fundamental economic and biological aspects that underpin enterprise production and profitability they are referred to as enterprise specific KPI (step 2). An example of an enterprise specific KPI for a pig breeding enterprise is the number of piglets sold per sow per year as this reflects the central role of sow productivity in all pig breeding enterprises; another example is the price of essential inputs, such as the price of potato seed in potato crops.

Step three recognises that farms are distinguished by their heterogeneity which effectively means that different constraints apply on each farm. Therefore, farm specific KPI are based on the personal and business constraints of the benchmarker's enterprise. It is clear that differences in the combination of resources must partly explain the wide range of technologies and farm management practices observed in farm surveys. The farm specific KPI need to be chosen so that they measure the productivity and performance of the resources that most seriously constraint profit: it is especially important that those resources that impose a ceiling on enterprise profit are worked at their full capacity.² For example, a farm specific KPI is often the fertility of the soil. In general those farmers with the most fertile soil will achieve the highest yields, and, again in general, a higher proportion of the highest yielding farms will be in the industry standards reported for the top quartile. Farmers with poorer quality soil should not aim to match these yields, as by doing so their marginal costs are likely to become larger than the marginal

2. Clearly some KPI may be fall into more than one category; the important thing is to use this system to identify which KPI need to be compared rather than prolong the debate over which category to place the KPI in.

revenue, and therefore benchmarking without consideration of their own constraint will have effectively lowered profits.

The steps in section 2 involve comparing enterprise generic, enterprise specific and farm specific KPI with industry standards to identify performance gaps. Step four requires the benchmarker to select the most appropriate comparative survey or surveys from which to take the industry standard/benchmark: Table 2 shows some of the surveys available for milk producers. Where there is a choice, the benchmarker must judge which survey most accurately represents industry performance and their needs. The selection should be based on:

- The likely accuracy of the estimated industry standard, which depends on the sample size, its geographical spread and how the sample was selected.
- Whether the reported survey findings are raised to the national level.
- Cost of access to the survey results.
- Timeliness of publication of the survey findings.
- The complexity of the methodology used to calculate the KPI.
- The actual KPI presented in the survey findings, especially which farm specific KPI are reported by each survey.
- The number of sub-samples for which financial performance is reported; e.g. overall sample average, top and bottom deciles or quartiles as ranked by financial performance; enterprise size; region; farming system and technology.

Step five requires the benchmarker to use the same methodology as that used in the survey to calculate the KPI. Using the same definitions of costs, revenues and financial performance is essential to ensure like-with-like comparisons. Some of the key issues that need most careful consideration to achieve this degree of standardisation to produce like-for-like measures are presented in Table 3.

It is not until step six that the benchmarker begins to identify KPI gaps i.e. areas of underperformance. Comparisons with the full survey sample (the “average farm”) indicate relative competitiveness vis-à-vis the industry. Additional information can be obtained by comparing against sub-samples selected by top and bottom performers, farm type, enterprise size, region and farm system, and against farms with a similar over-arching constraint (i.e. similar farm specific KPI). Innovative processes revealed in comparisons of farm specific KPI are more likely to be directly applicable to the benchmarker’s own farming system, and therefore are more likely to lead to really worthwhile insights and changes. If financial performance is similar to the highest performers in the constraint-limited sub-sample but nevertheless poor compared to the full-sample average, benchmarking has provided evidence that the enterprise will not be viable in the long term unless the over-arching constraint can be removed.

It can be beneficial to benchmark KPI over time to reveal information on the trajectory of enterprise/farm performance. The final action plan (sections 3 and 4, Table 1) should take account of performance trajectory as it can indicate; (1) the urgency with which a change needs to be made, (2) the magnitude of that change, and (3) the effectiveness of previous actions plans.

Table 2. A Comparison of milk production enterprise data collections and their reporting arrangements.

Organisation	Name of Study	Sample size (farms)	Av. Size (cows)	Region	Farm selection criteria	Data collection	Data presentation	Top and bottom	Comments
DEFRA	Special studies	380	Raised data	England and Wales	Larger than 10 dairy cows. Full time farmers.	Full-time investigational officers. Free to farmers.	Written report every 4 or 5 years	25%	Robustness of findings Stratified random sample, raised data, comprehensive report.
HSBC/ADAS	Spotlight	91	Unraised	England	Dairy GM>90% of farm GM HSBC corporate customer	Bank manager (from accounts) Free to farmer	Written report Annual.	25%	Bias towards larger, specialist dairy enterprises, and farmers with overdrafts
Kingshay Farming Trust	Kingshay Premium Dairy Manager**	>700 (up to 1 500)	Unraised	UK	Dairy Enterprise.	Self submitted. Clear instructions to participants. Farmer financed (membership).	Quarterly updates. Monthly and rolling averages Region. 14 special interest groups (i.e.similar systems). With own budget. Web based.	With best herds	Membership fee will bias sample, however, large sample size may help to off-set this.
Promar international (Dairy-manager com.)	Milk minder and herd Profit Monitor***	1,700	Unraised	UK	Dairy Enterprise	Self submitted. Farmer financed (membership)	Web based system, with many subsamples available for comparison	10%	Membership fee will bias sample, however, large sample size may help to off-set this.

*All group report averages.

** Kingshay Dairy provided some information to non-members, and offers three service memberships: Starter Package, Regular Dairy Manager and Premium Dairy Manager (which has full costs of milk production.

*** Promar International offers several service memberships, Milk Minder goes to margin over feed, the Herd Profit Monitor includes allocation of fixed costs

Table 3. A Comparison of data collection methodology (relating to milk production enterprise).

Organisation	Name of Study	Methodology									
		Blank *	Drill down*	Rent	Interest	Own labour	Forage costs	Herd replacement costs	Leasing quota	Gross margin	Net margin/surplus
DEFRA	Special studies	Yes	No	Imputed	Assumed non paid	Imputed wage rates (lab only)	L Us	As paid	Adjusted for leasing in and out	For dairy Ent's	For dairy Ent's
HSBC/ADAS	Spotlight	No	Yes	As paid	As paid	Private drawings	Costs not allocated between Ent's	As paid	As paid	Whole farm	Whole farm (Surplus)
Kingshay Farming Trust	Kingshay Dairy Manager**	No	Yes	As paid	As paid	Imputed (labour and man')	Farmers views Own Experience	As paid	As paid	Yes	Yes
Promar International	Milk minder	No	Yes	Allocated "fairly"	Allocated "fairly"	Private drawings	Allocated "fairly"	As paid	As paid	Yes	Yes

* There are two approaches to costing enterprise. What is termed here "blank" refers to surveys where costs and returns are built-up from invoices and receipts (i.e. the analysis starts with a blank sheet of paper). Those referred to as "drill down" use financial data farmers have compiled for other purposes and then decide on the division of cost and revenues between enterprises.

** Depends upon the service contract taken out by the farmer. This level of service refers to the Premium Dairy Manager.

For example, intervention to reduce a KPI gap is likely to be conditional on whether that gap is increasing or decreasing and the rate of its change.

Section 3 involves the analysis of performance. Once a performance gap has been identified, it must be profitably corrected. Step seven investigates the causes of any KPI gaps. The value of benchmarking is considerably improved when industry surveys publish qualitative, descriptive KPI which reveal the underlying production processes used on the better farms (lack of such information is a considerable limitation to the wider uptake of benchmarking as a managerial tool). Economic surveys need to report a wide range of widely agreed KPI; these must include *inter alia* descriptions of the farming system, relevant input:output ratios (which give an indication of the technology used on the farm), and marketing strategies. Using this information along side sub-samples ranked by financial performance gives an initial assessment of the potential financial returns from changing the system to that of the most profitable farms. The uniqueness of individual farms may mean that some performance parameters achieved by the best-in-class farms are simply out of reach, for example, output and input prices may vary regionally. Farmers need to plan on the basis of what is practically achievable.

Step eight involves consulting the “best practice” literature to help identify strategies for improving enterprise performance. Unfortunately, not all farm enterprise surveys report the KPI needed for the benchmarker to determine the changes needed to improve performance. This limitation has been commented on above, but it is unrealistic to expect all possible farm specific KPI to be routinely reported (though if the survey data was made available interactively over the web farmers could interrogate the survey findings by whatever categories they chose and even generate performance measures to compare against their own KPI). In these circumstances farmers need to consult the “best practice” literature to identify and formulate potential changes to improve farm performance. However, searching out this information can be a time-consuming and costly activity, so benchmarkers may seek to acquire this information by joining a discussion group or visiting pilot/demonstration farms.

Section 4 involves costing possible action plans, selecting those which are profitable and implementing them. Step nine involves assessing the impact of a change on whole-farm profitability. A potential problem of benchmarking individual farm enterprises is that changes in one may adversely affect the profitability of another. If this results in a reduction in overall farm profitability it makes no sense to make the proposed change. This is a particular problem for enterprises which receive revenue from direct payments as eligibility for payments is based on stocking levels across the entire farm not simply on each enterprise.³ Claims may be restricted because forage area is used to support more valuable claims for another enterprise.

Step ten involves formally estimating the profitability of the proposed change. To justify the resources allocated to benchmarking, the benchmarking activity has to (1) be able to identify what changes are necessary and (2) indicate the cost and benefits of making these changes. The best practice

3. This particular example is likely to become less of a problem once the changes introduced in the Mid Term Review have been introduced – subject to the eventual cross compliance obligations attached to the single farm payment.

literature increasingly provides a guide to the costs and benefits of achieving best practice benchmarks, for example, the financial estimates presented with best-practice benchmarks in “PD Plus” (MDC, 2004). Although these estimates are derived from standard costs and prices, it provides a methodological framework into which farmers can put their own costs and prices to arrive at estimates of the change in profitability for their own enterprise.

In general, benchmarking needs to identify shortcomings and help correct them. But benchmarking may be valuable to farmers even when it does not identify profitable changes. Some farmers like to be top performers, and are willing to incur costs associated with benchmarking to maintain this status. For others, confirmation that their enterprise is not financially sustainable may help them devise an exit strategy.

More far-reaching changes require whole-farm budgets and perhaps estimates of the pay-back period and return on any capital that may need to be invested. Potential changes can be usefully categorised into those not involving capital investment and those that do. Those that involve no or very little capital investment and limited disruption to the farming system such as, for example, joining an input purchasing co-operative to lower unit input costs, are in general likely to be the most cost-effective changes. However, where larger changes are needed the riskiness of the investment needs careful consideration. Where benchmarking has shown poor enterprise performance and that investment cannot be justified on financial grounds, the benchmarker needs to consider other options, such as closing down the enterprise.

Step eleven involves implementing the action plan. Benchmarking should not be a one-off activity, rather it should involve regular and periodic measurements and assessments over several years to reveal business trajectories (Slavin, 1994). Having made the initial investments conforming with the earlier steps, it is less time consuming to take standards from the same survey each year. Together this suggests that industry standards should be taken from a well established survey which regularly report consistently defined KPI.

Discussion: increasing the use of benchmarking as a management tool

Partial benchmarking

A major limitation with increasing the use of benchmarking is that the steps outlined above guarantee more work but offer no guarantee of any benefit. To lower the costs of benchmarking, many farmers conduct some benchmarking activities which fall short of following the systematic steps outlined in Table 1. There may be benefits to conducting such a “partial” benchmark. For example, Ashworth (2002) discusses the benchmarking of gross margins. He believes it is useful to benchmark at the gross margin level as, although this will not include fixed costs which are a large element of enterprise costs, it does force managers to ask questions about how the business is managed. This must be correct. Moreover, gross margins are widely understood and their use avoids possible confusion over how the

survey allocated fixed costs (although, as there are alternative methods of allocating some costs between variable and fixed costs, even gross margin comparisons do require some degree of research and care). However, the problem with partial benchmarking is that it may lead to inaccurate conclusions as to the best way to develop the farm enterprise or the whole farm business in the long-term.

Horizontal and vertical benchmarking

Benchmarking has traditionally referred to farm-with-farm and enterprise-with-enterprise comparisons, i.e. horizontal benchmarking. For horizontal benchmarking, the over-arching purpose is to determine how to improve performance rather than to compare financial performance *per se*. Clearly, successful performance has different meanings to different people depending on their aspirations and circumstances, and Byles (2003) reminds us that “success may include criteria such as job satisfaction, family well-being, credibility and growth”. Where this is so, it will be reflected in the KPI they chose to compare. However, as the statements from the Policy Commission stated above indicate, benchmarking is more typically associated with identifying opportunities for enhancing financial returns (economic efficiency) and raising production (technical efficiency).

For benchmarking to improve performance it must be able to identify what is going wrong and what needs to be done to put it right. In fact, benchmarking should be associated not with comparisons of financial performance *per se* but with comparisons of farming practices and farming systems. This is why, for horizontal benchmarking, the actual definition of financial performance is not as important as the need for the benchmarker to compute the chosen measure of financial performance using the identical definition as that used in the survey.

However, this is not so when benchmarking businesses at different levels in the food chain (vertical benchmarking) when looking at profit margins and the share of the consumer price is generally under inspection. These businesses are not engaged in similar activities so there is no benefit from identifying the processes used. In vertical benchmarking the definition of financial performance is more important, and it must be (1) easy to interpret and (2) common to all businesses along the food chain.

This requirement can be illustrated by reference to the financial performance measure used in a recent report on the economics of milk production (Colman *et al*, 2004). The key measure of enterprise return is ‘net margin’, with the definition clearly defined (page 21) as a measure of the return to management and investment after all other factors of production have been paid an appropriate return. This is a sound measure to use for horizontal benchmarking, but fails with respect to interpretability and compatibility when used for vertical benchmarking. Net margin is often interpreted as showing economies of scale in dairy enterprises, which results in farmers being advised to increase the size of their enterprise. But as dairy enterprises increase in size the farmer and spouse spend a larger proportion of their time on “management” rather than “labour” tasks. As “management” charges are not

subtracted from net margin, this measure of financial performance is positively biased to show economies of scale. This also makes 'net margin' an inappropriate measure for vertical benchmarking as such a measure must be comparable with measures of financial return reported by public limited companies, and these certain make full deductions for management charges and costs.

Benchmarking other aspects of production

More recently, benchmarking has been applied to (1) environmental outputs of farms and (2) energy efficiency. Comparisons of environmental outputs need agreement on the measures that should be used, and work is currently being undertaken in the UK to identify appropriate comparisons, for example the "Application of the National Sustainable Agriculture Indicators to Farm Level" project being undertaken by the Agriculture and the Environment Research Unit (AERU) at the University of Hertfordshire (AERU, 2003). It is easier to identify measures to use to compare energy efficiency, but there is currently a lack of comparative data to indicate norms and best practice, though this is being addressed by the Farm Energy Centre.

Strategic organisation of benchmarking activities

To be able to benchmark successfully each of the following elements external to the benchmarker have to be in place:

- Availability of comparable data.
- Timeliness of published comparable data.
- Comparative data needs to be drawn from a robust sampling framework to accurately reflect industry performance.
- Definitions have to be clearly explained.
- Appropriate key performance indicators need to be available.
- Sufficient sub-samples need to be available to allow the processes/system comparisons.

The current strategy towards extending benchmarking is to increase the number of farm enterprise surveys. For enterprises without surveys generating industry standards this is sensible, but for those for which surveys already exist, such as milk production, any new surveys need to substantially improve on those already available for the initiative to be sensible. For these enterprises, the appropriate strategic response may be to reduce rather than increase the number of surveys and data collections. The money saved could be used to improving the remaining surveys by, for example,

- Additional checks on the accuracy of the data entered in the survey.
- Improve the timeliness of publication of survey findings.
- Reducing the confusion caused by the different definitions of KPI used by each survey.
- Increasing the richness of the data presented to include more process

type, whole-farm systems data reported by the survey.

- Producing a measure of financial performance that can be directly compared with the financial performance of other businesses along the food chain.
- Allowing resources to be used to develop decision support tools and to support econometric analysis of the data which could identify, for example, the marginal benefits of changing farming practices and to identify examples of best practice used on farms that achieve better performance than others in their particular class.⁴
- Allow resources released to expand benchmarking to include more environmental aspects of production. Sustainable aspects of production that could be benchmarked include crop rotation, nutrition balances, soil management, biodiversity indicators, energy and water use and waste management.

These improvements could be expected to reduce the existing limitations on the effectiveness of benchmarking and thereby increase the use of benchmarking by farmers.

Rationalisation of the organisations which collect data will not be simple. Whilst each organisation generates performance measures and KPI they do so for different reasons. For example, the FBS is charged with producing data for the EU's FADN network⁵ of farm accounts and private organisations produce information which is demanded by their fee-paying membership. Integrating these organisations so that each enterprise is serviced by a single large survey with participants selected at random from a stratified sample would require considerable diplomacy and negotiation.

Conclusion

Traditional benchmarking refers to horizontal benchmarking, whilst few farmers appear to undertake formal comparisons it is likely that many benchmark informally, for example, by comparing crop yields against national and regional average yields reported in the farming press. Basic benchmarking such as this can be built upon if the payback to benchmarking can be increased; the benchmarking exercise needs to deliver benefits to the benchmarker.

We argue that if farmers follow the eleven steps presented above they will have done everything within their own power to increase the likelihood of raising the payback to benchmarking. However, some determinants of the potential returns to benchmarking are outside the control of individual farmers. One way of raising the payback includes adding more process and descriptive information on the farm practices of the best farms and in other ways (listed above) improving the comparative data available. The key concept underlying horizontal benchmarking is the need to compare "like-with-like", hence

4. As the average farm is a combination of results from different farming systems, there can be some risks and pitfall in using averages in farm planning (see Upton and Casey (1973)).

5. FADN is the Farm Accountancy Data Network. Every year the EU collects accountancy data from a sample of agricultural holdings in the EU. Their findings are available from the European Commission.

industry standards are often reported for sub-samples of farms drawn from the full survey, e.g. for farms in similar regions, of similar size and top and bottom performers. However, surveys can be made more relevant to farmers if they reported results for sub-samples classified by each farm's over-arching constraint. Such comparisons offer genuine benefits, as they indicate the highest financial returns that can be expected subject to that constraint. Such a comparison also indicates the value to a farm of releasing that over-arching constraint.

Moreover, there may be benefits from reducing the confusion arising from the wide range of definitions used to report survey findings; reducing the number of surveys and data collections reporting industry standards would free resources to improve the accuracy and value of those surveys that remain. Industry standards from randomly drawn, stratified, large samples will be more representative of national performance. Any additional resources could be used to report a wider range of price and unit cost data and process type information along side the financial performance measures. There has been an expansion in the UK of discussion groups and pilot (monitor) farms which are a particularly good way of disseminating practical, process type information about unit costs, prices, farming techniques and best-practices and how to identify and overcome key constraints to enterprise performance, i.e. exactly the type of information that are often poorly reported in industry standards.

There are several areas in which benchmarking can be expanded. One area is vertically benchmarking; that is comparing performance with other businesses in the food supply chain. The Policy Commission (2002) discusses the "Efficient Consumer Response" approach which requires sharing of benchmarking costs and margin information so that "all parties [along the food chain] can thoroughly understand the economics of their industry". However, despite considerable encouragement to enhance co-operative and collaborative management of food chains, some sectors are not prepared to publish transparent financial information. A recent example of this is reported in the DEFRA sub-committee into milk pricing;

"Despite our best efforts in this inquiry to determine who takes what share of the retail price of a litre of liquid milk, we were still unable to account for some 18 pence," (Defra, 2004; p. 3).

Farmers must weigh-up the benefits from horizontal benchmarking against the potential disadvantage of gifting confidential financial information to other sectors in the food chain which have no intention of producing financial margins for their own businesses. Moreover, there is a danger that financial data designed for horizontal benchmarking may be used in vertical benchmarking and so misrepresent profit margins along the food supply chain (as argued above). Nevertheless, future developments of benchmarking will focus more on how the food chain delivers consumers' expectations. Without more co-operation this development will need to await changes in the ownership of businesses along the food chain. Another area in which benchmarking needs to develop is its international dimension. An international dimension is available for milk and pig production, and is indeed

being developed for other enterprises, there is still much to do. The UK must not be 'blind' to important aspects of current and emerging competitive threats. A third area is related to the changes that will be introduced in the Mid Term Review which will emphasize marketing arrangements. At present few farm survey findings report farmer's marketing arrangements, and surveys need to address this omission. Finally, industry standards need to report more information on the environmental and sustainability aspects of agricultural production.

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Biographical Notes

Dr Jeremy Franks is a lecturer in Farm Business Management at Newcastle University. His main research interests involve agri-environment policy, the economics of milk production and its marketing, whole-farm and enterprise financial analysis, and the measurement of economic and technical efficiency.

Michael Haverty graduated with distinction in the MSc in International Agricultural and Food Marketing from the University of Newcastle upon Tyne. He recently held the post of Research Assistant at Newcastle University examining the principles, practices and the development of benchmarking in a business context, to develop a systematic, holistic and concise benchmarking tool for farm businesses and enterprises. He will be shortly undertaking a traineeship with the EU Commission in Brussels. He currently hopes to follow a career in management consultancy providing advice on business strategy and competitiveness.

CONFERENCE PAPER

MANAGEMENT EXPERIENCES OF A PART TIME FARMER¹

Graham Dalton²

Objectives, business relationships, system development and interactions set the context for financial control and tactical and strategic decisions. Time management, problem analysis, economic and accounting tools are informally used as events unfold (such as the new single farm payments) and confidence grows in a continual search for improvement.

Key words. Part-time farming; decision making, financial management, single farm payment, educating managers.

Introduction

It may be that only a few of your future students will benefit from any experiences of part-time farming which in my case is in UK terms a small business. However, as reported by Moss *et al.* (2000) in Northern Ireland one of the main responses to the changing fortunes of agriculture is for many small farmers and/or their spouses to find off-farm employment. It is an attractive way of solving the farm income problem since it avoids the need to finance large amounts of capital in order to expand a farm business or all the costs, especially of housing, of leaving agriculture altogether (Gasson, 1983). Some part-time farmers have large enough businesses to employ professional managers. Others like myself, in that we enjoy the process and other benefits of life in the countryside could be termed “hobby” or life style farmers. For all of these reasons part-time farming is an activity which is unlikely to disappear. Moreover, we should remember that in world terms most farmers are in one way or other part-time farmers if we define such people as farmers who have small farms and who have off farm income generating activities.

The paper begins with an enumeration of objectives followed by an examination of the specific characteristics of my own part-time situation. In describing the business I shall emphasise the many and varied business relationships that are necessary for the business to function as well as the normal physical and financial descriptions we set out in conventional student farm-visit handouts. These relationships are the key to operating within the constraints of the business.

As a career agricultural economist who has specialised in farm management the most difficult part of the paper is to describe how I actually manage the farm. In the literature I think I am best described as a “cautious strategist” characterised by informal approaches, self financing with a strong emphasis on lifestyle and unwillingness to take risks. I have been fortunate enough to have my own laboratory. I do not use many of the techniques that I have taught and written about; rather I adapt the methods of thinking. I will describe some of the challenges that I believe are both central and difficult. I

1. Paper presented at the Educating Managers for the 21st century, Agriculture and the Countryside one day conference, Reading University, and is printed here by kind permission of the organisers.

2. I would like to thank Dr. Catherine Milne of SAC for her assistance in writing this paper

will set out the approach in most detail by describing my current thinking about the single farm payment.

Finally, I conclude with a short list of topics based on my experiences which I believe might be useful for the future work of the farm management unit.

The Farm

Goals and Objectives

1) The most important goal is consistent with the “cautious strategist”³ - I must not make a loss! I did make a loss in the first year of business (1976) and for a few years in the late 90’s when I was permanently abroad and in the year the sheep shed burnt down. This objective has meant that separate accounts have always been kept for the farm even though decisions can only be really made with respect to all my activities. However separate farm accounts means that the contribution, or otherwise, of the farm to family welfare is monitored and clear. The corollary is that while losses have not been significant, neither have we made much profit - in a good year about £60 an acre. There are the usual difficulties of allocating expenses for cars, farmhouse, fuel - we try not to deceive ourselves or the tax authorities.

2) In the short term, losses can be avoided by not spending but such a policy results in running down the capital base of the business which is not one of my objectives. A dilemma is thus to invest in facilities which sustain the farm but in the knowledge that you are not renewing facilities that are really redundant. So we have invested in drainage, on maintaining soil fertility, on fences and on a new sheep shed. Facilities such as a cattle crush and pens and sheep equipment are forced on you for reasons of safety and both your own welfare and that of your animals. Farm assurance schemes are also requiring this type of investment. Road safety concerns convinced me, against my better judgement, of recently acquiring my first new tractor! We have a fully equipped office which is a shared expense with my main employment. In these ways I hope we have cared for the fabric of the farm. We try to limit major investment projects to one per year so as to handle them well.

3) A related objective to the above is to run the business well and this contributes to another “must” objective that of enjoying the farm, at least for most of the time. Part of this enjoyment expressed in marketing terms is to try to achieve a fair degree of production “quality” in that there are premiums for this and your reputation goes before you (remember too I worked for SAC). In the past year for example, 22% of our lambs were graded R, 64%U, and 14% E, at an average of 21 kgs deadweight and were all sold by the end of September. In operational terms I am afraid that while all the gates do not swing it is not enjoyable to see jobs to be done everywhere you look or to be unable to complete tasks because of broken equipment or a lack of planning.

3. Rolf Olsson of the Department of Economics of the Swedish Agricultural University classifies farmers into four different types; 1) the cautious strategist, 2) the entrepreneur, 3) the defensive strategist and 4) gambler. According to the author the first two types tend to be more successful.

For this reason keeping the fabric of the farm shipshape is important.

4) One practical way in which the goal of reducing risks is achieved is to buy in as few animals as possible. Experiences with enzootic abortion in sheep and BVD in cattle have thus brought about a policy of home bred replacements.

5) Over the years our objectives have changed. Both my wife and I enjoy the space and the place as well as the flora and fauna, much more than we did. We have skylarks, sparrows, geese and field fares. We hope we can encourage hares and lapwings to return. We have planted a small area of trees for conservation purposes with finance from the local authority which is the city of Aberdeen. We would not like to see the land built on.

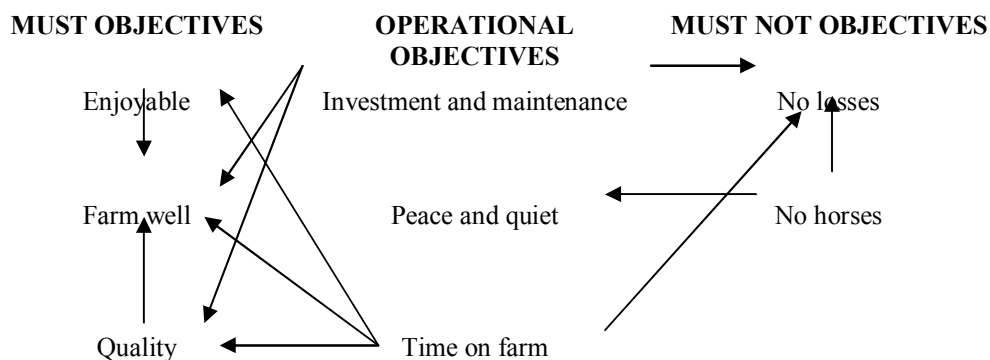
6) The business has also grown, with the acquisition of another 40 acres in early 2001 and renting seasonal grazing. The main reason for this was the difficulty of covering the inexorable rise of unavoidable fixed costs with declining real margins on produce. Land in 2001 seemed to be a good investment and so far this has proved to be the case. But growth is not an important objective unless it can be easily managed.

7) There is a strong local demand for livery but my keenness on good pastures (farming well) and our peace and quiet have meant that a policy of “no horses” has been preserved.

8) As to the future, our children don’t wish to take on the farm so there are no intergenerational issues to be taken into account. Planning permission has just been obtained to convert the old cattle and grain store buildings into 2 houses which, are consistent with my expectations that the unit is not likely to be retained in its present form. But we do not intend to build houses for the moment.

Some tentative interactions between the various types of objectives are summarised in Figure 1 below.

Figure 1 Interactions between various types of objectives.



Physical features

The main farm of some 75 acres of grade 3 land is situated within the Aberdeen city boundary some 7 miles west of the city centre, in a rural setting with fine views of the Grampian Mountains, is south facing and is on average 150 metres above sea level. An additional 40 acres, 10 of which is rented is situated some 6 miles away. The farm is designated as being within a less favoured area of the disadvantaged category.

The modernised house with large garden was built in about 1860. The traditional buildings can house some 80 cattle in 4 courts, and the floor grain drier can store 100 tonnes of grain. A modern sheep house/general purpose shed can be used to in winter 120 ewes and 40 ewe hoggs. There is a small earth walled silage pit complete with effluent tank. The steading is serviced with mains water, 3 phase electricity and drainage is by septic tank.

While all the land can be ploughed some 26 acres is kept as permanent pasture. Fields boundaries are mainly of stone dykes or post and wire fences. There are 12 fields ranging in size from 4 to 16 acres. There are 2 small paddocks adjacent to the steading. Soils are a sandy loam but have an underlying impermeable iron pan that means they lie wet in winter and stones of all sizes appear every time the land is ploughed. The farm is in a Nitrate Vulnerable zone.

Cropping and stocking

The ploughable land is usually cropped with spring barley typically for 4 years followed by four years temporary grass. This provides the basis of a clean grazing system for the sheep and cattle with annual alternate grazing of swards. The yield of spring barley is usually at least 5 tonnes/ha with expectations of 6 tonnes/ha with 80 kgs of Nitrogen. Soils are naturally acid and low in Potash.

The mixed farm system is based on March/April lambing of 120 ewes and 40 ewe hoggs (with 135 units of ewe quota) which are kept for fat lamb production off grass. Their winter diet is based on silage and propriety sheep cake. This year 260 lambs were reared and this is in line with the normal lambing rate.

Limousin cross calves from 17 spring and early summer calving suckler cows are all born and finished on the farm on grass, cereals and silage (quota is held for 19 suckler cows). All cattle are wintered inside in straw courts.

The aggregate stocking density has been maintained (with difficulty) just below the extensification scheme level of 1.4 livestock units per hectare and so we qualify for the highest level of subsidy payment. Seasonal grass lets have usually been taken to achieve this. Bullocks have normally been kept on for the second retention period of the beef special premium scheme but can get too heavy (over 400 kgs deadweight) as a result.

External services

A list of suppliers of goods and services is shown in Figure 2. This list

which is not atypical, demonstrates the reliance of any farm on external services. In most cases, except for governmental bodies, business is done with a known individual without any formal contract but with an understanding of the mutual benefit of doing business with each other⁴. There are paper contracts for sales of cereals and with the Scottish Environmental Protection Agency (SEPA) over the disposal of spent dip as well as membership of the farm assurance schemes. The basis of the trading relationships is payment of bills on time and an obligation that your word is final plus wherever possible expressing appreciation for a good service. This year, for example, I sold my grain on my mobile phone. I have never met my lamb buyer but have talked to him by phone in the season every Monday morning for a number of years, wherever I happen to be, when we arrange the price, number and delivery time to the abattoir. I have bought breeding animals unseen from people I trust. The cattle buyer, by invitation, comes to the farm to select the stock himself and once this is done and agreed, there is little chance of another outlet being considered. That is not to say that I do not compare and challenge prices wherever possible and get competing quotes for the main items of expenditure including professional services. The main transaction cost is the value of my time so there is great value in knowing where to get what you want and where to sell what you have, in the knowledge that you are going to get good service.

We are using the internet more and more and find that once you have learnt the system it is much more convenient. However, for trading, I feel it is preferable to be able to deal with a person I know. I have had particular difficulties in this regard with my bank where the convenience of BACS payments and electronic transfer is very much welcomed but at the same time it is very difficult to access, let alone negotiate with an individual with the authority to resolve an issue straight away. Systems such as the Government gateway for VAT and subsidy claims such as IACS are beginning to become more user-friendly. The electronic registration of cattle and cattle movements is now an excellent system.

Constraints

These have changed from when my wife and I first came to live on our farm in 1976. At that time I had a new and demanding job, we had a large mortgage and two small children. Now I have retired with a pension, we are unencumbered and our daughters are independent of us. My work has always been the way in which our living expenses have been financed. It has meant that the need for a given level of family income has not driven any growth in the size of the farm business.

I am almost in complete charge of the business but when contemplating really big changes the agreement of my wife is essential. Her life is centred in Aberdeen so, for example, moving further away from the city to a bigger farm is not an option for her.

In 1976 we had no practical experience other than what I remembered from my agricultural degree and from my upbringing. Overcoming what

4. Kay, J. (1996) argues that the study of how wealth is created is a rich area of economics which has been neglected in the pursuit of ways of controlling aggregate economic behaviour. This is very good news for farm management!

Figure 2. List of suppliers of goods and services

Vet and Veterinary Investigation Unit
Drugs and medicines
Crop protection chemicals, crop walking
Feed, Minerals
Seasonal grass lets, Winter sheep grazing
Straw and sawdust
Breeding animals -rams, heifers and bulls
Other livestock equipment, tags
Fertilisers
Sludge
Lime and lime spreading
Fuel and lubricants
Casual labour
Machinery supplies and spares, tools
Haulage
Contractor for crop cultivations and harvesting, drainage, fencing, shearing,
Digger
Fencing supplies, posts, wire and gates
Trade- plumber, electrician
Building supplies and repairs
Quarry - sand and gravel
Pest control
Professional - accountant, lawyer, architect, Maps (ordinance survey),
Planning, SAC, Bank
Information, magazines, HGCA/MLC, teletext, web sites, journals,
newspapers, professional societies, show society. abattoir club
Insurance, - buildings, cars. tractors, employer, public liability, National
Insurance
Office equipment and supplies
Merchants for Grain, Wool
Buyers/auctions, abattoirs for cattle and sheep
SEERAD and Animal health,
Utilities - BT and Scottish Southern Electric, Scottish Water, SEPA, and
Transco (pipeline), Post office
Ghillie (game keeper) - access to river, and shooting arrangements
Farm assurance schemes- cereals and livestock
Waste disposal services, knacker

seemed at the time to be insuperable challenges gives you confidence that you can actually farm. There are areas of expertise where I still do not have either an aptitude or much confidence e.g. machinery. I have gained confidence in

many technical things and in such tasks as marketing by auction. Keeping up to date is a continual challenge and my job and contacts in SAC were of great benefit in the past; now I miss them.

The farm is small both in area and in financial terms. Just over 100 acres with the system I now have, has gross revenue of less than the salary of the job I retired from. This was not the case when I started farming. The farm has neither economies of scale nor more importantly size and increasingly you cannot justify in financial terms the ownership of modern equipment or buildings. Reconciling the aim of doing things well which requires modern facilities and the aim of making a profit is thus challenging. From the point of view of suppliers and processors there is little advantage to them of dealing with you. You are often “not in the know” and I feel you can easily be exploited. Smallness in some circumstances can be overcome by group activity such as buying fertiliser and fuel. Dealing with utilities is I find especially difficult since it requires great persistence to find the person in charge and usually the concern is urgent.

You are short of time especially as you are away from the farm in business hours and in my case out of the country for several months over several years. This means you cannot make do with unreliable kit. When I am away there must be reliable back up in place. Also things do go wrong and this can be both dangerous and expensive.

Whereas the “leisure ” time put into the farm can be regarded as free, to be productive this time has to be skilful and be provided by an able bodied person. The physical demands of farming have to be recognised. Farms are also potentially dangerous places for the untrained and inexperienced. As a retired person I have more time but am more prone to make mistakes and am not as able.

The opportunity cost of my time influences the amount of time that I have available for the farm. Some very rough calculations show me that my earnings per unit time, when I am working off the farm, are some 6 times greater than on it. It might be argued that the higher my off farm wage rate, then the time needed to earn our required living expenses is lower, so that more time is available for my own pursuits. It is certainly the case that the wage rate required for me to take on off farm work is much higher than what I can earn on the farm and reflects the weight I give to the enjoyment I get from farm work. My case is however somewhat special in that experiences of my work on and off the farm are complementary.⁵

Management

Balancing constraints, resources and objectives is the main function of management and the following describes how this is done on my farm.

Care with machinery purchases.

My experience as a farm management advisor taught me that it is all too easy to justify “buying” yourself high and unchangeable fixed costs (depreciation

5. For example, as a pre-accession advisor to the Polish and Romanian Ministries of Agriculture, practical experience as a recipient of CAP subsidies was invaluable.

and interest) in the form of machinery and equipment a) because it would make tasks easier, b) you would be independent and organisational tasks would be easier and c) especially when you have the money in the bank. The latter occurs with my system in the late autumn when most sales and subsidies are drawn. It is easy to forget the long wait till next years receipts occur.

Labour

Most field work is done on contract, (including crop walking) except for fertiliser spreading, pasture topping and turning hay, silage or straw which I do myself. All feeding and livestock management is also done by me when I am at home, failing which, this too is done with hired casual labour. Other tasks such as drainage, fencing, building, shearing are also done by contractors.

There are jobs I have to do because I can't find anyone prepared to do them. Gathering stones, running repairs to fences, gates and walls, drains and keeping an increasing number of obligatory records and plans are examples. My wife keeps the accounts and reconciles these with the bank. I conduct all buying and selling. For many years we employed a pensioner who worked every week day morning but such people are hard to find.

Spin offs from the extensive use of contractors and casual labour is that you buy in expertise and that net margins can be more easily estimated.

System interactions

The importance of system is a very strong influence on the method of farming and the decisions that are made. Sheep to do well and to be easily managed require clean grazing that can be provided with cattle. Thankfully, a recent test for wormer resistance proved negative. Cattle utilise straw and feed from the cereal enterprise which in turn is a good way of disposing of manure. Cereal yields are both higher and more certain after a grass break and are a good way of renewing pastures. Thus, the value of gross and net margins is moderated by these technical complementarities which can only realistically be fully captured in whole farm accounts and budgets. The system has evolved over the years. Fat lambs off grass have been the main enterprise. Land for cereals and grass for cattle grazing were originally let out on a seasonal basis. There followed a period of buying in 400kg + store cattle for fattening which due to the difficulties (time, skill and moral hazard) of buying such animals led me to a suckler herd. Livestock numbers grew and for the past ten years or so I have rented grass on a seasonal basis. The system I now operate has thus evolved over the years.

Some observations about the system are that:

- i) Farm assured quality is easier to verify with the home produced system that I have, but mixed farming has a much greater number of tasks to be performed than a more specialised one. To be successful all tasks must be done well.
- ii) I believe it is easier to farm on a bigger scale than in a small way since you can more easily acquire and justify the specialised facilities and expertise. But

there are more risks and responsibilities as well as a greater physical challenge. More specialisation would simplify the business but the risks would be greater.

iii) There are interesting technical challenges to low input farming. You probably need to be a more able farmer to make a success of low input systems than high output systems. For example, establishing, utilising and maintaining clover swards. It is also valuable to think of which variable inputs increase risk (fertiliser) and those that reduce it (fungicides) (Hardaker L. J *et al.*, 1997).

iv) As well as the known difficulties of allocating costs and returns to enterprises within an accounting period there are also allocation problems according to different time periods. This is clearly shown in the estimated single farm payment that I may receive from next year but which is based on the subsidies to the system that I had in the years 2000 to 2002. These subsidies were enhanced by the purchase of land and grass lets during this time period. I did not know this when the basis was being set. There are other technical examples mainly for expenditure on animal and crop health where the benefits of current expenditure are spread out over a number of years or conversely where a loss will influence a business for some years to come.

Time Management and organisation

My own time management given the demands of other employment and being away from the farm is an important task along with good planning, communication and relationships with contractors and casual labour. An awareness of what delays can cost in terms of lost output is an important driver. Tasks such as receiving deliveries and loading cattle and grain need to be well organised. The ATB course that I attended so many years ago has been of very great value to me. I still remember the slogan, “do it now” and the importance of prioritisation - not only making lists of jobs to be done but marking the individual entries on that list that must be done first. The importance of the question “should someone else be doing this?” has also never left me as is the emphasis on the importance of having enough time just to think, obtain ideas and new perspectives. Tasks can be fitted around other employment such as lambing in the Easter vacation when we can get a student to help and growing early cereal varieties so that harvesting tasks can be done in the evenings.

Search for Excellence

The desire to do things well and indeed its importance for profitability is reflected in a continual process of searching for excellence. Changing practice is constrained by the following questions;

- do I have the confidence?
- I have the skills?
- have I got the facilities?
- will it pay?
- can it be financed?

Over the years a set of practices and procedures have on the basis of failures, successes and general experience grown up. The quest for excellence relies to a great extent on importing new ideas from outside the business and is assisted by observation, reading, asking questions, discussion with contacts and thinking time. Things do go wrong, usually unexpectedly, and here again I refer to an ATB course I attended which has proved most valuable, that of Problem Analysis.

Problem Analysis

It is a human reaction to an undesirable event to jump to conclusions. Experienced people sometimes become fixed in their views. Problem analysis helps to diagnose problems and situations more dispassionately and to systematically test hypotheses with the facts of the case. I probably use this process most with animal health problems. Examples where I did find the cause include cobalt deficiency in lambs and vitamin E deficiency in calves. The systematic approach of defining the extent of a problem, where and where it did not occur, when and when it did not occur and any change in recent practice have a very general application including dealing with the understandable human reaction that it was not my fault. Other applications include health and safety and the reasons why we make mistakes of all kinds.

Financial control

I do not construct a whole farm budget at the beginning of each year but instead monitor closely the cash flow situation as indicated by the bank balance. I carry this figure in my head and should I lose touch then it is soon updated. The cash situation this year as compared to last adjusted for any one off or special payments or receipts gives me a good feel of how we are doing and thus the control of expenditure. More importantly if this trigger is not where I expect it to be, then I will print out the cash book and do some simple analysis and projections. I also do these sums well before the end of the year to assess for example whether or not I can moderate any tax liabilities through capital expenditure allowances. At the end of the year I will have a very good idea of the likely profit before I send all the information to our accountant. There are critical technical control points such as the number of lambs and calves reared and cereal yields and quality. My informal system means that I get a more and more accurate prediction of whether I will make a profit or not as the year end approaches.

As a guide to how well I am doing I place much emphasis on the ratios of different types of expenditure in relation to output (the level of output is most important), the overall farm gross margin and changes in the levels of expenditure from year to year. One cost that I believe is always too high is my vet and drug costs. (They are so high that I suspect benchmark figures reflect much under recording!) Comparisons with previous year's totals for both costs and outputs are invaluable and I will spend some time analysing major changes when I receive draft accounts, usually 2 or 3 months after the end of

the financial year.

Day to day decisions

I am always using the logic of partial budgets in my head and on the backs of envelopes in order to justify or not the use of inputs and other decisions. Indeed my wife tells me that doing sums is one way I manage my stress levels! I find partial budgets essential and yet difficult to do mainly because the response to inputs and future prices are so uncertain and the logic of opportunity costs so illusive. It is easy to get your logic wrong or simply miss things out; a good example would be the management of the current subsidy regimes where chasing say the second beef payment, a) by keeping steers instead of bulls and b) for the second retention period, adds to the extensification payment but at the same time increases your stocking rate. The latter also depends on when calves are born and the pattern of sales which is sometimes held up by the situation at the slaughterhouse. On the cost side you feed extra rations for longer and the price you receive may be reduced if the beast gets too heavy or too fat. Crucial facts in the decision are thus how heavy is the animal, how fast will it grow, what will be its fat class and how much will it eat. You may also be constrained by building space, so that with an unchanged system, selling animals before they are two years old means that you are releasing space for calving cows but slight variations in timing can catch you out. If you are near the cut off point for the extensification stocking rate then as this supplements all your beef payments this dominates the decision choice. Other examples of decisions with similar logic include whether to sell lambs this week or next, to sell or store grain, whether to buy compound feed or use home mixed rations based on home produced cereals, if you keep more ewes than your quota, do they pay their way, what price can I pay for seasonal grass lets, whether to spray barley with fungicide a second time or vaccinate say for enzootic abortion or toxoplasmosis? The slogan, making decisions without information is most apt. I usually resolve these decisions with something of a shrug in that if I cannot easily decide, I assume it must not matter too much either way. The sums, however, are more often than not a way of clearing your mind and adding certainty to your actions. The memories of whether the decisions turn out to be right or not, if you can tell, certainly stick with you for at least a year and influence your expectations. Thus, I learn more by experience if I have agonised over what to do and if a mistaken decision was particularly costly.

Uncertainty

Handling uncertainty is more of a problem with investment decisions such as a new shed, more land, to attempt to grow seed barley or whether or not to buy a new tractor. Here my sums are supplemented with diagrams based on decision trees. I find the logic of a dilemma most helpful but often not entirely convincing! Such decisions are also assisted by good outlook information which I assume I cant afford to buy or invest the required time on the internet now I no longer work in my profession. There are plenty of random facts for

the price of a newspaper but little analysis. For example, last year the fact that grain prices rose between harvest and November by 50 % hardly seemed to be noticed. Most articles in the farming press were still about increasing yields by 2 or 3%. I felt I had made a big mistake when I accepted a contract at harvest for November delivery at £80/tonne and the actual November price turned out to be £93/tonne when the barley was collected. Worse perhaps I did not seek a contract for this year - the ex farm price at the time of writing is £61! The lesson seems to be that I really can pay more for information if it will change my decisions and if the costs of acquiring it take account of the opportunity cost of my time. Does such information exist?

Some of the pronouncements on the single payment are positively misleading such as the required rise in the price of beef to compensate for the changes in subsidies (the international price is very low). I will now turn to this issue since I have still not made a decision about what I should do even though I have done lots of sums!

The single farm payment scheme

In round (imperial) figures based on the subsidies received in the years 2000 to 2002, the single payment I may receive is about £100 per acre after modulation. The big change from the complexities of seeking the best profit under the current subsidy regime is that I do not need to keep sheep, beef cattle or grow barley to receive my "entitlement". My first question having read the draft regulation some time ago is that as far as I understand it I need not farm at all but will have to keep the land in good agricultural condition. Does this mean topping the vegetation twice a year? It would be a un enjoyable job but perhaps bearable for an annual fee of over £10,000 although the conflict with my formulated objective of farming well probably rules it out.

If this option is not allowable or acceptable then given my system, how can I ensure that I retain as much as possible of my single farm payment and not use it to subsidise my hobby? This question is really the same as finding out which activities on my farm (if any) are likely to be internationally competitive, that is, will make a profit without subsidies. The following is a crude attempt to find out based on the prices and performance for this farming year. I have simply worked out my net cash position for each enterprise which since almost all of the machinery and labour costs are in contract charges gives an accurate indication of net margin. Moreover, since the beef enterprise includes both calf production and finishing there are no problems of internal pricing (Figure 3).

Observations

Beef is very dependent on subsidies. In Scotland we are to have a coupled "beef envelope" for suckler cows which would subsidise all calves born. Even so, on these figures it seems they should be dispensed with except for the argument that they facilitate clean grazing for sheep. The theory from production economics also shows us that where there are complementary relationships between enterprises, even with large shifts in the slope of the iso-revenue line (relative product returns), then specialisation is not a rational choice.

Figure 3. Net cash margins for 2004 for each enterprise and farm as a whole.

Item	Beef	Cereals	Sheep	Farm
Sales (net of replacements for livestock)	£8 806	11.53 hectares of cereal @ 5 tonnes = 57.65 tonnes @ £61 = £3 804 176 bales of straw @ £3.50 = £616 (charged to livestock)	£11 800	£25 026
Subsidy	£6 878 (BSP+SP+ 30 month +Extensification +share LFA	£2 512.78 (Estimate)	£3 060 inc share of LFA	£12 450
All cash costs including normal variable inputs and contracting charges for growing crops and forage	£8 219 (£483.47/cow)	£4 444.31 (£385.45/ha Or £77/tonne)	£6 956 (£43.47/ewe)	£19 619
Overall Net margin	£7 465	£2 478.47	£7 907	£17 857
Net margin without subsidy	£586	-£24	£4 844	£5 407
Net margin with subsidy per unit	£7 465/17cows =£439	£214.91/ha	£7 904/160(incl ewe lambs)=£49.4	£17 857/48=£372/ha.
Net margin without subsidy per unit	£587/17 cows=£34.52	-£2	£4 844/160(incl ewe lambs) =£30.27	£5 407/48=£112.64/ha

NB The overall stocking rate is slightly less than 1.4 livestock units per hectare to comply with the higher rate of extensification premium. The number of forage hectares is 36.51 giving an overall margin from all livestock of £15 369 or £420/ha or £149/ha without subsidy.

All these figures are for a single year - 2004. Last year, for example, which was an exceptionally good year for cereals, the net margin including subsidy for cereals was £4 558 or £395/ha (£218/ha without subsidy). Sheep have been excellent in 2004 and beef sales have been slightly down due to BVD.

Livestock are more competitive than cereals except in a good year (see footnote to table above) but doing without home produced straw would require a change in the cattle wintering system. I recall straw costing over £10 per round bale some few years ago.

Simply spreading the existing number of sheep out over all the land could well with the single payment produce an equivalent total farm net margin since few purchased inputs would be required. In other words the sheep would become grass toppers. I would plump for around 200 ewes. I need to do a whole farm budget to test this out.

An interesting deduction about the breakeven price of seasonal grass lets that I could afford to pay next year can be made from the farm net margin per ha without subsidy. These figures assume similar production and market conditions next year. The breakeven figure of £112.64 /ha is much lower than the rates this year but farmers with more entitlement than land they own and high rates of single payments could afford more. Are there many such farms in my locality?

What will be the market response to the single payments? How far would prices have to rise for cereals or beef for the ranking to change and is this likely? Conversely, if most mixed livestock rearing farms come to the same conclusion what will happen to the supplies and price of lamb?

Sheep are apparently more competitive since I don't pay the market rates for most of their inputs; they require very little winter feed and no cultivations. Moreover, their performance seems to be relatively good. Would such performance levels be sustainable with complete specialisation?

The above figures do not capture the capital implications of selling the beef cattle and a whole farm budget would allow this. However since cattle have the greatest capital requirements the conclusions are likely to be reinforced.

Following on from this point, since I have recently been granted planning permission to convert the cattle buildings and grain store to two houses, the value of the resources released (their net of tax opportunity cost) add an overwhelming financial case to the decision to at least sell the cattle. Of course the same argument can be used concerning the value of my own time but what would I do with the money? I would probably be more able to continue to enjoy myself keeping a few sheep!

Conclusions regarding Educating Managers

Research Topics

At the core of farm management practice are objectives. It is a difficult process to both set these down and to be aware of their interaction. A reality test of what your objectives really are can be made by looking hard at what you do and on your reactions to choices you have to make. The importance of the farm and family situation on how a part time farmer runs a farm and responds to policy and market changes has I hope been clearly demonstrated⁶. Goals and objectives, other than maximising income, do drive decisions because of the fact, for example, that living expenses are not wholly dependent on farming activities. I would probably not make a loss if I did not change my system in response to the new single payment provisions, especially if I were to alter the balance of enterprises. Are cattle essential to the enjoyment I get from the farm and to the performance of the system? Can I physically manage the cows as I get older? Are cattle more of a tie when I am away? Can I improve the performance of all the enterprises sufficiently to alter the ranking or should I specialise in what I appear to be best at? If the old steading were to be converted to housing would this result in too much disturbance and what about bio-security? The new policy environment brings out or reveals preferences that I did not write out.

If we justify the use of the maximum profit criterion for choice in our methodology by the preponderance of larger agribusinesses, then even in this situation we can find in the literature much evidence of the influence of personal preference in the board room. System theory points to the importance of dealing with boundary errors to bring about good analysis. Real decisions are influenced by human conditions and perceptions in both farm families and

6. For some theory see Ellis, F. (1988)

companies so they need to be taken into account. It is often the case that objectives only become clear when a proposal for action is made in which case any analysis may (usually does) have to be repeated. Thus for all these reasons, tools which recognise the importance of objectives must be part of our educational effort (Dalton, (1967).

The iterative evolutionary way of making choices is another reason why I believe most farm management tools are not formally applied outside of the classroom. As noted, objectives cannot be set down precisely and in addition technical responses and price ratios are not known with certainty. Working out a monthly cash flow for one year or even three years ahead, or describing a farm in a decision matrix with precise coefficients is too much of an abstraction from the real situation. The information required is only partially available and most farm managers have insufficient processing capacity to calculate the best outcome (most farm managers and students for example have difficulty with estimating cash flows). Decision matrices that include multiple objectives, capital resources, time and risk quickly become very large and complex. This is not to say such calculations do not have value but they are not sufficient in themselves to deal with the reality of managing a farm. I thus believe that a heuristic approach of continual modification of future profit estimates based on an accurate current cash position as events unfold is necessary and unlikely to mislead especially if the critical points of the financial performance of a farm business are correctly identified (akin to a financial hazard analysis). The same kind of logic is also most useful in making operational or day to day decisions. Choices are made as they present themselves through time using the logic of marginal theory as captured by partial budgets. Now that computers are increasingly available on farms then the adoption of this approach is to my mind much more feasible since cash statements are likely to be up to date and the removal of the need to do manual calculations means that updates of projections are feasible.

Teaching

The decision making schema of Ohlmer et al,⁷ points to the central importance in management of acquiring information through the processes of paying attention and information scanning. One of the complaints about our students has always been that they don't seem to read. What do you see is always a good question on a farm visit. Close and accurate observation is so important for picking up problems and finding and implementing solutions on farms. Using production economics theory we can categorise information/knowledge into three components, namely of technical relationships, economic conditions and financial performance. I wonder if we have the balance right in what we teach when we spend so much effort in imparting knowledge about the techniques for making choices. Do we teach what we know (get published) rather than what would be useful? How much agricultural science do farm management students need to have? What can we teach them about the outlook for prices through the study of economics?

7. Ohlmer, B. *et al.* (1998) define the following phases of the decision process; i) problem detection, ii) problem definition, iii) analysis and choice and iv) implementation. In each of these phases, sub-processes such as information searching, paying attention, finding options, evaluation and choice and bearing responsibility take place.

Should statistics be obligatory? These are perennial issues and the pressures for provision of teaching on these topics are changing. My view would be that foundation courses on these topics are essential. For example, you need to understand probability theory to be able to think about risk. You need to know about the characteristics of supply and demand of agricultural products to make judgments about future prices. A series of foundation courses in crop and animal growth and health, soil and water management, agricultural engineering and conservation as well as the directives and regulations that are now in place in the sector are also in my view necessary. Such courses may well be attractive to many students and in future may well be taken at the post graduate level.

Consultancy and Training

The rough analysis of enterprises that might be the most competitive on my farm illustrates an approach to a strategic problem. The history of the development of many businesses (e.g. Parrish, 2004), including my own, shows that strategy is decided on, in a similar way to tactics. Strategy evolves through time rather than being chosen at one moment and is continually monitored and reviewed at each decision point. It reflects not only expectations concerning changing external events and the farm family situation but the process of learning and growth in confidence. Key decisions such as the choice of enterprises and major investments are taken with the best knowledge and analysis that can be done at the time. Reviews of strategy are however time consuming so it seems logical that they will be done according to the timing of opportunities or of important changes in external circumstance such as the current introduction of single farm payments and a reduction in market protection.

I share the uncertainty with other farmers of what my response will be to the single farm payment scheme. What analysis should be done and what criterion for choice should I use? Is it correct to try to design systems such that the single payment is not spent on subsidising farm operations given the cross compliance conditions? Expectations about market developments are also crucial for formulating with sufficient confidence different possible future scenarios. Benchmarking is another form of information that clearly has a role here in helping to identify business strengths and weaknesses.

Transferable Skills

I referred to training that has assisted me in tactical management such as time management and problem analysis. I have not been on a course concerned with organisation although critical path analysis teaches us of the importance of identifying priority tasks. These experiences raise the question of the transferable skills of our students. How do they improve their time management, organisational skills and most of all their confidence that they can do things? My observations from the post graduate management course (FBOM) run in Aberdeen for many years was that a course based on case studies did put students under time pressure and forced them to both organise

themselves and also to work in teams which gave them experience of transactions. At the end of the course, most of these students, having survived, felt they could do anything! I do not see how it is possible to develop these skills with distance learning methods.

Lessons for the Profession

A conclusion I have drawn from setting out as best I could how I actually manage is that the tasks and skills to run a part time farm are much the same as those required to run a full time farm or any kind of operation including a department in an academic institution! The main differences are the goals and objectives, the available resources and prevailing constraints. It may be that the small size of my farm business makes it easier to manage in a more informal way but I would also contend that success does require a thoroughly professional approach.

I would identify from my experiences at least three necessary sets of knowledge to achieve this required professionalism.

i) That there is a thorough understanding of financial tools and an ability to use them properly with all their imperfections and assumptions to make better decisions (a corollary of this statement is that our tools are useable in practice). Our students must be able to choose the right tool according to the problem, get the logic right and make accurate calculations based on relevant information and most importantly be able to draw conclusions that stem from their analysis. My experiences of being an external examiner is that this goal is a difficult one to achieve. In that financial tools are what we mainly find in our texts and courses, then we must improve on what we do.

ii) Success depends not only on how well a farm system is put together and operated but on the ability to continually improve performance. How will this be done? The farm management unit here has a history of contributing to “lifelong learning” but given the importance of being able to farm in a globally competitive situation I believe the value of this work is now more important. The title of educating managers for the new century implies a commitment to this endeavour. A programme in my view should include methods and tools, transferable skills and information that is relevant to farming including technical and economic topics. The difficulties of defining true objectives must surely be a topic where a short participative course would have great value. The programme might include issues such as the new policies, but there are many more. The profession does not in my view have much to say on tactics in farming. If it did then enterprise management courses would be the way to do this.

iii) Decisions, both tactical and strategic are difficult to make. Our theories and tools only assist the process. Specifically, given the decisions now facing EU farmers about their response to the single payment system (and less protection) what methods of thought and useable tools do we advocate? I am mindful that this conference is being held in Reading where comparative

analysis and other tools of farm management have been developed. It is an important time to propose (yet again) a simple, easily adopted contemporary guide (or a UK version of the farming systems approach) to assist the review of farm businesses and the development and evaluation of options.⁸ Farmers to whom I have spoken about the new policy are of the view that they will adopt a wait and see approach. This is a defensible if you are uncertain. Implementation means that you set out on a likely irreversible course of action and for this you need to be sure not only of the short term gains but of the consistency of the decision in meeting your objectives in a number of likely longer term scenarios. An acid test of the relevance of the farm management discipline is that it should at least speed up the process of reaching the point of action and so avoid the substantial costs of simply waiting for market developments to make things clearer.

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Biographical Notes

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CONFERENCE PAPER

EXTERNAL EFFECTS OF MITIGATING MEASURES TO REDUCE LARGE CARNIVORE PREDATION ON SHEEP

Leif Jarle Asheim and Ivar Mysterud

Economic externalities of mitigating measures to reduce sheep losses to carnivores are not sufficiently addressed in Norwegian nature management. Evaluating such measures involves a "scale" problem: outfield (i.e. open range) grazing sheep have quite small home ranges, large carnivores from hundred to several thousand km². Because these ranges are a different order of magnitude, exposure to mitigating measures taken in any sheep home range area might influence predatory behaviour outside that area. These external effects impact on society, the environment and other farmers and could outweigh any advantages. Scale consideration is of crucial importance in designing field research projects to explore such issues.

Key words: carnivores, external effects, home range areas, livestock guard dogs, predation, preventive methods, sheep losses.

Introduction

In many areas of Norway losses of sheep to predators are considerable. During the 1990s losses increased as the number of protected predators increased, even though investment in mitigating measures also increased over the same period. The importance of this issue is reflected in the two White Papers issued by the Norwegian Parliament relating to large predator policy (Ministry of the Environment, 1991-92; 1996-97). A third White Paper is due to be released in 2003. At the same time as the third report is being completed, several preparatory papers and reports signal a new direction in predator policy. This new direction aims to differentiate policy geographically (Linnell *et al.* 2003) and by predator type. If these directions are put into practice the whole country will probably become an active "predator management area". However, the measures to protect the carnivores will depend on the geographical area, the pattern of conflict and the species of predators present. While the conflict with grazing sheep is the focus of this paper, there are other areas of conflicting interests - such as acceptance of the predators by the local human population, the interests of game hunting, conflicts with outdoor recreational life and with the interests of the Sami reindeer herders. These factors may be even more controversial. In the final analysis, it is the views of the human population concerning the number of predators that can be supported that is key. These views would be based on their willingness to bear the economic costs that might determine the population of large carnivores (i.e. what we have termed the "social carrying capacity").

1. This paper was presented at the 14th International Farm Management Congress, August 11-15, 2003, Perth, Australia and is reprinted with kind permission of the organisers.

The introduction of efficient mitigating measures against predation on grazing animals is of prime interest to the Norwegian nature management agencies. During the preparation of the first two White Papers a whole suite of mitigating measures was explored and several projects initiated to test their validity (Linnell *et al.* 1996, Mysterud and Gautestad 1996, Mysterud *et al.* 1996). Recently, high cost projects have been undertaken to test several of these measures and to estimate the cost of implementing them. The political imperative is to achieve an acceptable mix of grazing animals, reindeer herding and predators, whilst providing opportunities for outdoor activities such as berry gathering and hunting in large area; i.e. providing a policy that satisfies different interest groups. This is a demanding requirement, which encourages the contrivance of efficient and cost-effective mitigating measures.

Another co-operative investigation between industry and the government has attempted to identify and select mitigating measures. So far, the loss reducing effect of the different measures seems limited because they do not work as expected, are too expensive or have other disadvantages (Dahle *et al.* 2002). Many of the most promising measures, for instance patrolling outfield pastures with dogs (an example discussed in this paper), also appear to incur important but as yet unexamined external effects (externalities). Whilst their application appears to generate interesting and “promising” results at the local level, these un-appraised external effects may mean that these measures could be seriously flawed when transferred to the national level.

Before commenting on the design of mitigating measures, we present a brief outline of the system of sheep production in Norway to convey an understanding of the main uncertainties associated with the various mitigating measures as they relate to the geographical scale at which sheep are grazed and over which predators operate.

Rangeland use by sheep and predators

A combination of fenced farmland and outfield (open range) pasture is the most common way of Norwegian sheep farming. Norway has a summer population of approx. 2.1 million animals grazing outfield pasture and 0.3 million or so grazing farmland for the entire summer. On some islands with little snow and no predators sheep may graze outfield pasture unattended the whole year. Lambing takes place in April or May with spring grazing as soon as pastures allow. Normally, spring grazing farmland pasture lasts about 30 days. In mountainous areas and the Northern parts of the country sheep may be fed indoors for up to three additional weeks, and sometimes are released directly on the outfield pasture.

Summer grazing on outfield pastures and on open ranges in forested or alpine areas lasts for around 100 days, from the beginning or middle of June (Asheim 1986). While free ranging sheep may have large areas available to them, studies of sheep home range area, using radio transmitters, reveal that they do not move very long distances. Sheep home range areas have been found to vary with breeds, and can be from 2.2 to 33.8 km² (Gautestad *et al.* 1996). In spite of the limited grazing period, sheep from a particular farm tend to return to the same area year after year (a form of site fidelity behaviour – the tendency to return to certain geographical locations or “loyalty” to certain

points in the home range area). Another observed grazing pattern is the utilisation of the pasture: sheep form small flocks or smaller family groups that cover a few square kilometres. When sheep are collected during the latter part of September about 80% are gathered through specially organized grazing groups. Gathering of the sheep is a community act with farmers walking over the whole range and gathering all the flocks into a common facility where they are sorted. The grazing group in each area report the number of animals released and gathered in their area to a central office producing statistics of sheep losses in all areas.

There are four large carnivore predators of sheep: lynx (*Lynx lynx*), wolverine (*Gulo gulo*), brown bear (*Ursus arctos*) and wolf (*Canis lupus*), which, together with the protected golden eagle (*Aquila chrysaetos*), constitute one of the main problems for the sheep industry in Norway. For lynx the home range varies between 158 and 433 km², wolverine between 61 and 970 km² and for the brown bear from 171 to 33,041 km² (Gautestad *et al.* 1996). For the golden eagle habitat size has not been measured, but it will definitively exceed that of sheep. More recent studies (Linnell *et al.* 2001) show considerably larger home ranges for lynx under Scandinavian conditions.

There may be sporadic predator attacks on sheep while grazing within fenced farmland, but most such losses occur when sheep graze on outfield pastures. On the open range sheep are normally unattended but under different degrees of inspection, and a certain number will die owing to diseases or accidents. The mortality rate will vary locally depending of the presence of rough terrain with cliffs or waterholes in bogs etc. According to the central organisation of the grazing groups (Øvervatn *et al.* 2001) the losses have averaged 5.5-6.0% since the mid 1990s compared to less than 4% in the 1970s and the 1980s. If grazing is disturbed or if lambs stray from their mothers or the mother have been killed, the yield and quality of harvested meat are detrimentally affected. While bears seem to prefer ewes, the other species prey predominantly on lambs.

Any assessment of the impact of these losses on farm profitability needs to take into consideration the cost of additional labour needed for searching for lost animals and for identifying the causes of any losses. This is because the Norwegian system for compensation payments for predation-related losses puts the responsibility for proving the cause of losses on the farmer. This can indeed be very difficult and labour-intensive, as often no remains of the sheep can be found. When carcass remains are discovered, it can also be difficult to prove whether a predator was the cause and which predator species was involved. This may be one reason that the majority of lost animals are not compensated for. However, in some incidents where the predator cannot be identified, compensation may still be paid if it is assumed that the predator was a protected species.

The Norwegian population of wolves are located in the border area with Sweden and connected to a larger Swedish wolf population.

When the predator is identified it is most commonly a lynx or wolverine; fewer losses are attributed to predation by brown bears or wolves. The number of predators in Norway was officially assessed in the early 1990s to be between 5 and 10 wolves, 700 - 1,000 pairs of golden eagles, 20 - 25 brown bears, about 200 wolverines and between 300 and 400 lynxes (Mysterud & Mysterud 1995). In the late 1990s and early 2000s these estimates had increased to a minimum of 28 wolves, 773 - 1,072 golden eagles, 26 - 55 brown bears, about 271 wolverines and between 400 and 500 lynxes (Andersen *et al.* 2003). The resulting significant increase in losses and compensation payments has focused attention towards identifying and implementing mitigating measures. Clearly any measure taken to reduce predator related sheep losses is of prime interest to the nature management agencies. Among the mitigating measures tested have been fencing off parts of the range pasture, moving the sheep to another pasture (if that can be found), early gathering or later release of sheep, night pens and herd inspectors (with and without different breeds of guard dogs), guarding the sheep or patrolling during the night. Simultaneously with projects and field-testing, Flaten and Kleppa (1999) examined the costs associated with such measures. A core problem is that a calculation of the external effects cannot be carried out because of lack of data from local projects.

Research design implications

The evaluation of these mitigating measures to reduce predation on sheep grazing outfield pastures must address the actual effect of the measure on predation and losses. Economic losses, whether borne by farmers or by society (through compensation payments), must be carefully considered. Losses with and without the measure must be known in order to compare the effects of the measure. In addition, the *external effects* on society, the environment and on other farmers need to be considered. Obviously these requirements increase the difficulty of conducting such studies, which require careful planning, the use of adequate control areas and control periods in the case of comparing the losses with and without the measure. Not all research projects meet these design requirements.

Some important ongoing field research into mitigating measures suffers from what we will refer to as the "*scale problem*". Sample- and control-areas need to be large enough for events within one of the areas to be statistically independent. An area may be selected so that events are independent between areas as far as *sheep* spatial behaviour is concerned, but the area may not be large enough for *carnivore* behaviour (Gautestad *et al.* 1996) to be independent. *Since the home range areas of sheep and predators do not coincide there may emerge a form of statistical dependence.* Exposure of carnivores to mitigating measures in one sheep home range area might influence the behaviour of and time spent by the same carnivore in a "neighbouring area". Scale evaluation might therefore be of crucial importance in designing field research projects. Here we show an example of this when the mitigating measure is patrolling outfield pasture with guard dogs.

Patrolling outfield pasture with guard dogs has been of focal interest in Norway. Some recent research indicates this measure may be working locally

on pastures with widely dispersed sheep (Hansen *et al.* 2002). This mitigating method differed from the standard use of guard dogs (see Green & Woodruff 1991), as it was performed by dogs following a range inspector patrolling in 5 hr spells three nights a week. This measure was employed over three summer seasons on a total of eight sheep flocks, involving three inspectors and four dogs in three research areas; Amirfjell (in 1996 and 1997), Krokafjell (in 1997) and Vadfjell (in 1999). Each area is located in Hattfjelldal, a municipality in Northern Norway with a total area of 2,682 km². Lynx, wolverine and golden eagles were the main predators present.

Hansen *et al.* (2002) compare the losses in the respective areas before, during and after the measure was introduced. Significant reductions (χ^2 , $P < 0.001$) in the number of sheep lost were achieved in one of the study areas (Amirfjell) in both 1996 and 1997. In 1998 and 1999, when there were no dogs present, sheep losses increased (χ^2 , $P < 0.001$). "Promising" results were also recorded in Krokafjell (χ^2 , $P < 0.1$). The authors claim, however, that *lack of significance* in the other areas was mainly due to the *size* of the area and the *quality* of the dogs. The range patrolled by one man/dog unit should not exceed 10-12 km² and the dogs should be experienced guard dogs properly socialized for this work. The size of Amirfjell is about 12 km² whereas Krokafjell and Vadfjell are 30 and 40 km², respectively.

The method involves range inspections allowing dogs to *chase* potential predators away from the pasture before returning to the inspector. Interest should, therefore, be directed to examining external effects which were not considered by the authors. The straight-line distance between Amirfjell and Krokafjell is only about 10 km whereas Vadfjell is about 30 km from these areas. The predators might thus move from one research area to another and still be within their home range area, i.e. within the area where they would normally operate. However, the study by Hansen *et al.* (2002) fails to examine or pay attention to any direct extra losses caused on sheep in adjacent pastures. It seems, however, highly unlikely that any predator will stop its sheep killing activity because of the dogs.

A closer examination of the data provided by the authors even indicates that some effects might be found in the summer ranges where the method is *not* employed. In particular a strong *increase* in losses in Vadfjell in 1997 is noted. Losses increased to 14.8 % from an average of 7.8% for the three years from 1993 to 95. In 1997, the above mentioned method was employed in both Amirfjell and Krokafjell, causing a significant reduction in predation in Amirfjell whilst being only partly successful in Krokafjell. The results for 1998 suggest that some predators remained in the Vadfjell area the following year, corresponding well to the finding that predation losses were the lowest ever recorded in Krokafjell. Thus when a predator is prevented from hunting in a particular area, it appears to simply switch location and live and prey in another area.

Designing a study in which predators are *not* allowed to attack sheep in any area within the home range area of the predators would require research on a much larger geographical scale and a completely different project design. Even at a larger scale, establishing these mitigating methods might simply disperse predators around other less well-protected areas. The requirement on

dogs and inspectors per unit area would be so great that perhaps it would only be possible to protect smaller areas. We simply do not know the consequences and outcomes of operating these mitigating measures on such an extended scale.

In their study of economic analysis of mitigating measures against loss of predation Flaten & Kleppa (1999) claimed that several of the measures examined might incur *damage displacement effects*. Such effects were defined as "damage transferred onto other sheep farmers (within or outside the original area) that do not introduce the measure" (cf. "displaced losses"). Damage displacement effects may be transferred onto other domesticated animals or even game animals. Possible damage displacement effects will yield costs *exceeding* the costs for those implementing the measure.

Conclusion

Failure to take into account external effects on all farmers in the carnivore habitat may lead to wrong conclusions regarding socially beneficial outcomes, especially if the major cost of preventive methods against predation of livestock in Norway is to be supported by public funds. As more money is channelled into local mitigating measures, the transfer of costs and losses may lead to more conflicts instead of less if neighbouring farmers sense that the measure would simply chase more predators onto their own pastures. In the local community there may even arise conflicts between those who introduce mitigating measures and those who experience the external effects.

In general it can be maintained that the mitigating measures introduced so far work only at the local level in specific areas and with considerable costs. Problems arise regionally because such solutions cannot be employed on all farms, and damage displacement costs have not been estimated but may outweigh the local benefits. However, research efforts to improve the infrastructure of the industry by developing a (satellite based) service with a mortality transmitter on each sheep to quickly inform the farmer are in progress. The initiative may represent a long-term solution to the problem of finding the cause of some disputed losses.

On the political front, the Norwegian predator situation led to the passing of two Parliamentary White Papers during the 1990s. Yet another predator policy parliamentary report will be released shortly. However, we anticipate that because of the scale problem illustrated in this paper important baseline facts and measures might not be reliable. A full socio-economic analysis is, in our view, imperative. It is needed to correct for any external effects when evaluating mitigating measures. There has been no impact analysis of the increasing carnivore population so the basis for decision-making is weak and insecure. We conclude that carefully planned research, particularly dealing with identifying the appropriate design of the research project and focusing on the unexamined external effects, is still not available for use in Norwegian nature management. Instead of easing the political climate in carnivore management, we anticipate this lack of scale-appropriate research might increase the conflict level even further.

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CONFERENCE PAPER**WORLDWIDE AGRICULTURE - THE ISSUES¹**

Suzanne Blumhardt

This paper reviews the developments in the Doha Development Round of the World Trade Organisation (WTO) from a 'down under' perspective. It then discusses the impact of New Zealand's decision to unilaterally dismantle all trade distorting subsidies on the development of the agricultural sector. Based on a pragmatic approach to farming and by an almost obsessive attention to market signals, agriculture has prospered. Some examples of key responses in marketing and product innovation are presented.

(Key words: agricultural trade liberation, World Trade Organisation, New Zealand).

Introduction

Thank you for inviting me to talk to you today on issues in worldwide agriculture from an international perspective. As you will know, I am a New Zealander, so I will be looking at this subject from a 'down under' view point. I'm sure you will be aware that over the last 20 years we have unilaterally dismantled nearly all our import tariffs and freed up trade. All trade distorting subsidies have been removed from our industries. We have done this because we really couldn't afford the alternative, even if we wanted it. Our farmers took the biggest initial impact. But contrary to predictions, our agricultural industry has adjusted and demonstrated its ability to adapt and prosper in an unprotected environment. In fact it has actually increased its contribution to Gross Domestic Product (GDP).

It is this broad area of reform of international agricultural trade that I am going to focus on today. The current Round of World Trade Organisation (WTO) negotiations are perhaps the most obvious evidence of this move to a less protected, less distorted and more competitive international agricultural system. But there are other issues in play as well - such as changes to the way agriculture businesses are operating internationally, a reassessment by governments such as those in the EU about the use of subsidies, and new policy challenges as consumers' needs change. So, I will look at international agricultural trade liberalisation, and what this has meant for an agricultural producer like New Zealand, but I will also briefly address one or two other international policy issues.

New Zealand Agriculture

First, let me give you some brief background about New Zealand agriculture to put my comments in context. As I am sure most of you will know, New Zealand is a country with a similar land area to the UK but a population of just over 4 million. It has abundant rain and sunshine, and mild to warm temperatures, which means grass grows virtually all year round and livestock are grazed outdoors. Around 50% of the land in New Zealand is under permanent pasture and we have something like 70,000 farms. (Much of the rest is mountainous.)

More generally, agriculture, horticulture and forestry combined account for

1. This paper was presented on the 17th November 2004 at the National Farm Management Conference, Bedford, UK.

about 17 % of our GDP, around 10% of our workforce and over 60% of the value of our exports. Nearly all our agricultural production is exported - 90 % of all our sheepmeat and 95% of dairy production, for example. Dairy is the largest agriculture sector, followed by meat and meat products. Most of our agricultural production is traded on the open world market.

And to remind you all this is done without direct government support. Farmers' production and market returns are dictated by the market, not the government. There is no production-linked government support for any sector. The only direct support is in response to large-scale emergencies or climatic events, and even that is very limited. Regular government support is restricted to basic research and pest and disease control.

In terms of our export markets, the EU is today our second largest trading partner - 16% of our exports came here in 2003, including 3.4 billion dollars of agriculture produce.

Compare this with 1970 when Europe took 52% of our merchandise exports. The bulk of the difference was picked up in Asia, which went from 14% to 36% over the same period. But we also export to North and South America, as well as to Australia, the Middle East and the Pacific. The EU is by no means our only market.

While I am on background issues, let me also give a quick run down of how we see current agricultural market trends. The atmosphere for agricultural exporters looks very good at present.

In dairying we expect strengthening world demand, which should result in continued relatively high dairy prices. But we would not expect the current exceptionally high prices to be sustainable as they are in part due to temporary factors such as depressed Australian exports due to drought, and a weaker US dollar.

In sheepmeat current prices are high due to firm international demand for meat and continued lower production here in the UK in the wake of the 2001 FMD outbreak. In the wool market, prices for synthetic fibres have increased with the rising oil prices and are likely to lead to growth in demand for wool, provided the recovery in the world economy continues.

In beef the BSE scares in Canada and the US have dramatically reduced their exports and led to firmer prices and higher exports from New Zealand, although we expect prices to have peaked as US cattle inventory numbers are rebuilt. Venison markets are expected to pick up slightly following better market prices for some cuts and increased opportunities for non-seasonal consumption; kiwifruit is expected to remain stable and apple returns to fall as increased competition from other southern hemisphere producers kicks in.

In the more processed product area, we look forward to increasing volume of sales of our wine – but still at high prices.

The key message is that an improving world economy should be good for demand and prices, and we are optimistic on that score. But the overriding issue for New Zealand at the moment is our historically high New Zealand dollar, particularly when measured against the US dollar. This is really cutting into the returns New Zealand farmers are getting. This is perhaps a further example of the open nature of the New Zealand industry - where discussion around dinner tables on New Zealand farms is as much about currency rates,

hedging and the possibility of an overheating Chinese economy as it is about the weather. One thing we have shown in recent years is that the New Zealand farmer and our market diversification have made us resilient enough to cope with down-turns in demand caused by regional events.

Agricultural Trade Reform

So you can see that the international scene has a big impact on New Zealand agriculture – and indeed our whole economy. The basic quality of life of New Zealanders ebbs and flows with changes in international trade and markets. And we face some high natural hurdles - geography in particular.

The world looks very different from New Zealand. Think of it this way: if you drew a circle with a radius of 2200 kilometres centred on Helsinki (with Finland having a similar demography to New Zealand), that circle would contain 39 nations with a population of about 300 million. A similar circle centred on Wellington in New Zealand encompasses a vast stretch of ocean, our 4 million population, a few seabirds, and not a lot else.

That makes exporting from New Zealand more of a challenge, and is why we take very seriously liberalisation in international trade. We need to reduce as many man-made barriers as possible. If New Zealand agriculture is efficient, profitable and sustainable without government support or market distortions, we don't see why this should be restricted to New Zealand. Our aim is to do what we do well and to be able to compete fairly with other producers in world markets. We think this will be better for consumers, the environment, and for food sustainability.

While New Zealand is advocating free trade we know that it won't be achieved in five minutes. This is a long game. But fortunately for us there has been a move towards agriculture trade liberalisation over the past few years which has led to the current round of WTO negotiations - the Doha Development Agenda.

The last Round of WTO talks, the Uruguay Round, which concluded in 1994, did much to liberalise trade in industrial products. But it only just got started on agriculture. It did, however, mandate the start of a further round of negotiations on agricultural trade from 2000. Coinciding with this, and building through the late 1990s, was a wave of public debate driven in large part by developing countries and NGOs about the inequities in global agricultural trade - about the distortions created by rich countries' agriculture and trade policies which harmed the livelihoods of farmers in poorer countries whose natural advantages were in agricultural production. At the same time, and perhaps because of this, there was a growing awareness in Europe of the need to reform the European system of agriculture. I'm not going to go into any detail on this - this is your patch, not ours - but I will say that the political will within Europe for change in agriculture has been one of the big driving forces in the WTO talks.

At the Ministerial meeting in Doha in 2001 all members of the WTO agreed to an ambitious and wide ranging agenda for trade liberalisation – with agriculture at its heart. It had been clear that although negotiations on agriculture were already mandated, progress would be impossible without a broader agenda in which all countries could balance their gains and losses.

New Zealand supports what was agreed at Doha - that all three pillars of agricultural trade - market access, domestic support, and export subsidies - must be included in any deal. Our goal is to open up new markets, including in the developing world, and to improve the access we already have, for example in the EU and US. We are pressing for the end to the worst of the production-related domestic support measures that so distort global markets. And we are continuing to push for agreement on the end date for the elimination of all export subsidies.

The outlook for the Doha Round seemed pretty bleak a year ago when the Cancún Ministerial Conference ended without any agreement or any clear way to take the negotiations forward. There was a generally pessimistic mood, which provoked some countries to suggest that they would accelerate the bilateral trade route – seeking free trade agreements at bilateral or regional levels instead of pushing ahead in the WTO.

The challenge for the WTO is that its character has changed markedly, from a small club of mainly developed countries, to a body made up of some of the world's poorest nations, many of which find themselves marginalised from world trade, alongside major powers like the United States, the European Union and Japan. Finding consensus amongst such a disparate group would be a huge challenge for any organisation. Fortunately, for our interests and those of the global community, common sense seems to have prevailed with the successful agreement on negotiating frameworks in Geneva at the end of July 2004.

And I am pleased to say we have a result in the July frameworks package that is better than anything on the table at Cancún.

After Cancún political commitment to restore momentum to the Round could be seen across the organisation. There were conscious efforts to engage and involve developing countries both at home or at regional meetings, as well as in Geneva. And over the next ten months the EU made a major contribution through some key concessions, notably on elimination of export subsidies, and setting aside three of the four contentious 'Singapore issues' - investment, competition, and transparency in government procurement.

Agriculture was inevitably the key. The focus for the agriculture negotiations rested with the "Five Interested Parties" or FIPS - Australia, Brazil, the EU, India and the US. They made good progress, especially in the last few months. But the challenge was to get buy-in from across the WTO membership to the building blocks established by this crucial core group. This meant getting agreement from groups such as the G20, the larger developing countries, the Least Developed and African countries with problems over cotton and sugar, as well as Japan, and the Cairns Group to which New Zealand belongs.

This was not achieved without effort. Sleep deprivation was certainly a factor at the end with negotiators going for 40-48 hours at a stretch! It was bruising, and drawn out. It was touch and go to the end. But the result was one that met with genuine satisfaction across the WTO Membership. And that itself is quite remarkable.

What did we achieve? In agriculture, we have an historic commitment to eliminate export subsidies, the most egregious form of trade distorting support.

For the first time in 50 years, the debate will now be about when, and not whether we will do. On market access, while the language remains fairly vague, the framework provides the basis for arguing for an ambitious outcome as agreed at Doha, through substantial improvements in market access for all products, including sensitive products, by a combination of tariff reductions and tariff quota expansion. And the framework sets the basis for big cuts in trade distorting domestic subsidies – where the stage was set by the EU's CAP reform measures.

So, what lies ahead?

We are coming to the really hard bargaining of the negotiations. Everything will depend on the numbers. At worst we could see an ambitious outcome wound back to a very modest result. But what is important is we still have an opportunity to press for ambition. That is why these frameworks are so important, and why they are seen as an improvement on Cancún. The Doha Round is back on track.

The next major focus is the Sixth Ministerial meeting in Hong Kong in December 2005. In the meantime there will be considerable technical work across all the negotiating issues. There's plenty of room for hiccoughs along the way. But if we can keep negotiating focus on modalities as the "working hypothesis" for the Hong Kong meeting, we may be able to conclude the Round some time in 2006 or 2007. Then there would be a couple of years for implementation to start, and anything between 5-10 years to implement the commitments arising from the Doha Round. If we make it to a tenth Round, it could well be 2020.

Make no mistake, this is a turning point in agricultural trade. And that is why it is so critical. In the words of our Trade and Agriculture Minister, Jim Sutton:

"This comes at a time when it seems we are standing on the brink of what appears to be a major shift in the international trading system. It is a seismic shift equivalent to that of 10 years ago, when for the first time agriculture was included as an integral part of the multilateral negotiations known as the Uruguay Round. This time, in the Doha Development Round, the economic superpowers of the World Trade Organisation have recognised that agriculture is a vital part of this round and, as a consequence, have registered a readiness to see an end-date for export subsidies as an integral part of the outcome. The significance of this is huge: for more than 50 years, they have been defending the use of export subsidies. Their recognition that export subsidies will have to go in this negotiation is an enormous step."

It probably won't surprise you to hear a New Zealander saying this. But we genuinely believe that liberalisation of agricultural trade would be good for everyone. Yes, New Zealand would gain, but so too would developing countries currently shut out of much of the world trade, and consumers and tax-payers in rich countries, and ultimately farmers in those countries too. This is our experience in New Zealand, where you will not find a single farmer who would want to go back to the old days of government support and government control.

But it is not just in negotiations that WTO has an impact on trade liberalisation. The upholding of earlier WTO agreements is also important and there are some very significant dispute settlement cases underway which will have considerable impact on the way agriculture is supported, particularly in rich countries. The decisions against the US on cotton subsidies, and the EU on export subsidies for sugar, provide useful clarification of the rules on agriculture subsidies. They are also a signal that rich countries cannot continue supporting their inefficient agriculture sectors as in the past. While both these cases are on appeal, the initial finding that US cotton subsidies cause 'serious prejudice' to the interests of Brazil is a powerful reminder of the importance of the dispute settlement system.

We also need to keep in mind that it is not just in the WTO that pressure for trade reform goes on. All around the world there is a proliferation of bilateral and regional trade negotiations. And while these are second best to the WTO, New Zealand is also heavily involved in that game.

We have long had a closer economic relationship agreement with Australia which creates a free trade zone between our two countries. We have also in more recent times concluded a closer economic partnership agreement with Singapore. Currently, we have negotiations underway with Thailand, and also in a three-way trade agreement with Singapore and Chile. Brunei is proposing to join that "Pacific 3" agreement when it is completed. An economic study has been carried out in advance of negotiations starting next year with China. Malaysia and New Zealand are about to begin a study before deciding whether to initiate negotiations next year.

Talks with Hong Kong are still on hold pending movement vis-à-vis China, and studies have been held with Mexico. Other prospects are still in the wings, including ASEAN (in conjunction with our CER partner Australia) and Egypt.

The overall message I want to give on agricultural trade liberalisation is that there is a great deal of activity on this going on all over the world. The movement and momentum in global agriculture trade is in one direction - away from distortion, away from barriers and away from inefficiency.

Industry Developments

I would like to spend some time on how the industry is developing from a New Zealand perspective. As agriculture trade opens up and distortions are removed, agricultural industries need to respond to consumer and market demands. With less support and shielding from governments agricultural businesses have little choice but to be smarter, more adaptable and more efficient.

Interestingly, recent productivity and efficiency gains in agriculture in New Zealand are higher than other sectors of our economy. Our farmers and related industries have had to respond to new market opportunities, adopt new technology, seek ways to add value, and rethink how to do business, all in effort to remain competitive.

In the sheepmeat area for instance, New Zealand firms have moved from exporting frozen whole carcasses to further processing into frozen and chilled prepacked cuts and boneless products, and getting them quickly to market.

Sales of chilled lamb have continued to grow in response to very strong demand from supermarkets in Europe and North America. Advances have also been made in packaging, presentation, handling instructions and distribution, all of which have made our lamb a premium product in the higher-priced end of the market.

Traceability is another issue demanding attention. A New Zealand traceback system, based on DNA fingerprinting, has been developed which can pinpoint exactly where a particular lamb was farmed and give an assurance of its disease free status.

In dairying we also have a long tradition of innovation - from the introduction of spreadable butter to new forms of international marketing. Our largest dairy company, Fonterra, has for instance worked with Dairy Farmers of America to become the biggest exporter of skim milk powder from the US, and has formed alliances or joint ventures in a range of countries, including here in Europe with Arla. Another innovation is the newly developed low-carbohydrate yoghurt for the American market.

In some areas farmers have radically changed their farming practices, moving from meat and dairy in response to market signals, or subdividing their land for grape, olive and fruit production. Wine exports have grown from \$20 million in 1989 to over \$240 million now. Areas of farmed forestry have increased as land marginal for stock has been planted in trees.

Policy Issues

Related to these industry and trade reform changes, a range of other policy issues are having a growing impact on global agriculture. Today I want briefly to mention just three.

First of all, biosecurity. As the volume, sources and speed of movement of people and goods around the world increases, so too does the risk of exotic diseases that have the potential to impact on our animal, human, plant and environmental health.

The slightest hint of any serious plant or animal disease can have a material impact on all New Zealanders' livelihoods. Foot and mouth disease, BSE, Pine Pitch Canker: each could devastate New Zealand's economy. But not only this - our outdoor way of life and our unique environment (so important for tourism) is at risk from aggressive new pests. New Zealand therefore has one of the most comprehensive biosecurity systems in the world, which we are working to improve. Trade is a major driver for our approach - we cannot afford to have overseas markets closed for our products. But we also need to deal with biosecurity threats in a way that does not unduly impact on trade flows - biosecurity measures must be science-based and consistent and cannot become another arbitrary barrier to trade.

Secondly, sustainable development concerns are increasingly being addressed in agriculture policy discussions around the world. For New Zealand this has a particular economic implication given that much of our agricultural produce, not to mention our tourism, trades on our clean green image. The bottom line is that New Zealand's reputation for sustainable resource use underpins our market advantage.

There was a time in New Zealand when agriculture was all about making

two blades of grass grow where one had grown before and doubling sheep numbers. But not any more. Now farmers are more aware of the need to ensure their activities are sustainable. In fact removing government subsidies for agriculture was good for the environment in New Zealand. I mentioned earlier the reduction in unsustainable stocking of marginal land. In addition an open market system allows land intensive crops to be grown on the areas best suited to them. This in turn can lead to less intervention by the farmer and less chemical and fertiliser use. Our experience convinces us that you can have an internationally competitive agricultural system and at the same time protect the environment; the two objectives can be achieved together. And without a healthy environment farming will not remain sustainable indefinitely.

But that is not enough. There are also other developments. These are often led by the industry, or at least have the industry as a key player in joint arrangements with government. Environmental programmes do not have to be regulated by governments or controlled through subsidies. One example in New Zealand is the Dairying and Clean Streams Accord, aimed at cleaning up waterways and wetlands adjacent to or on farms. This is a partnership between industry, central government and local government. A practical result of the Accord is a recent agreement in the Wellington region that all 186 dairy farms no longer discharge effluent into waterways - ten years ago 35 per cent of those farms held resource consents to do so.

I want just briefly to mention one other policy issue which many countries now face - and that is securing the labour and skills needed to maintain the competitiveness of the agriculture sector. This problem is due in part to the structure of the industry. It is not easy to match labour supply with the demands of a large number of small-scale employers who are geographically dispersed. Also important is the fact that as we become more urbanised fewer people are directly exposed to agriculture and so have little understanding of the skills required.

We don't pretend to have an easy solution to what is a long term social issue. But we are working hard at it and have developed a pan-industry human resources capability strategy for the primary sector which we hope will be the basis for a combined government and industry approach. The key in New Zealand, and I suspect other countries as well, is the willingness of the primary sector to take responsibility for a more managed and long term approach to dealing with labour and skills issues. This is not something you can sit back on your farm and blame on government.

Conclusion

In conclusion then the big issue on everyone's radar screen should be the WTO agriculture negotiations. While we would not expect all distortions and protectionism to be removed from the international trade in agriculture products in one hit, we do expect, and will be fighting very hard for, a significant step in that direction.

New Zealand's experience over the last 20 years has seen our agriculture industry thrive in an environment based on a pragmatic approach to farming and an almost obsessive attention to market signals, and relying on innovation and openness to new ideas. As a result agriculture is now one of the most, if

not the most, innovative, efficient and productive industries in New Zealand.

We believe it will become more and more necessary for the formally protected agriculture industries in most other OECD countries to do the same. If we have a message to them, it is that liberalisation can be beneficial, not damaging. The WTO is pulling this agenda ahead, but even that is only in response to increasing demands for change from taxpayers, consumers, NGOs, developing countries, the odd pop star, some politicians, and increasingly even farmers. Internationally agriculture faces some real challenges, but we think this pressure towards less government intervention is good for everyone - not least farmers.

Biographical Notes

Mrs Blumhardt is the New Zealand Deputy High Commissioner in London. She is a career diplomat. As Deputy High Commissioner for New Zealand in the UK she has overall responsibilities for trade issues including those related to agriculture. Before taking up her current position she held various senior positions in the New Zealand Ministry of Foreign Affairs and Trade. In her last overseas posting she served as High Commissioner to Fiji from 1995-1998. She has degrees from Victoria University of Wellington and the University of Hawaii.

VIEWPOINT

MID TERM REVIEW – THE FRENCH REACTION¹

Michel Pivard

The paper considers how the French Government has incorporated the changes introduced under the mid term review of the CAP. It addresses some of the likely impact on French farmers from the author's perspective, as a fourth generation farmer, farming in Dorton, East France. It considers its implications for his farming system and discusses how farmers might react to these changes to generate the best results for their own farm businesses.

(Key words: Mid term review, France, family farming, diversification).

An introduction to my farming

My farm is located towards the east of the centre of France. It is a mountainous area close to the Swiss border, at an altitude of 500 metres. It is mainly grassland with permanent pastures, and it is at the limit of being able to grow maize for silage. Rainfall is around 1,400 mm/yr. (56 inches/year.). We have a continental climate; hot in summer and cold in winter (down to minus 15-20°C each year). Because of these factors, we have to house cattle from 10th of November to the 10th of April.

I farm in partnership with my twin brother. We have managed the farm since 1985 when we set-up a new dairy unit for 60 cows. Now the business has 350,000 litres of quota and 110 ha. of land. We farm two breeds of cow, about half of the dairy herd is Holstein, and the remainder Montbéliarde (a red, dual purpose breed). We feed the cows a diet of two thirds maize silage and one third grass silage during the winter. Despite the poor quality of the soil, we grow 15 ha. of maize and 7,5 ha. of wheat for feeding the dairy cows.

The milk is processed by a private company and is manufactured into soft creamy cheese: le Pave D'Affinois. Because of our involvements in various farming organisations and other businesses we employ a herdsman to work on the dairy enterprise. We do not use any straw for the cows, so we have to spread the slurry in the fields in a semi-urban area (the nearest town of Oyonnax with 25,000 inhabitants is 3,5 km. away).

Diversification

In 2001-2002 we started discussions with the town council about recycling the town's green waste into compost and using it as a fertilizer on the farmland. I had seen this activity on a farm close to a small town in Germany some 10 years ago. With the new environmental concerns and rules we thought it could be a good opportunity for diversification. We applied for a public contract which would supply us with 3-5,000 tonnes of green waste to process in to compost each year for 6 years. Our start-up investment amounted to €350,000 laying down a 7000 m² platform (in 2003) and during the first year we recycled 2,500 tonnes. Our calculations suggested a return on investment by the sixth year. Our cow slurry was injected into the compost to balance the nitrogen and reduce the problems associated with spreading raw

1. This paper was presented on 18th November 2004 at the National Farm Management Conference, at Bedford, UK.

slurry. The compost is a very stable fertilizer with no regulations as to when it is spread, spreading can be at any time of the year, and has no exclusion areas. We employ a full time worker on the compost platform.

The Mid Term Review (MTR): The French Recipe

The French 'recipe' for the MTR of the Common Agricultural Policy (CAP) is like our style of cooking: it involves many ingredients, lots of special touches, a mixture of different tastes, does not appear simple to do, but finally - what about the taste? In general we love it!

Ingredients (the general context)

The basic system is the Single Farm Payment with a touch of "recoupling". The reference date for the amount of SFP is the average premium on the years 2000-2002:

- The recoupling is 25 % in cereals and maize.
- Suckler cow premium –100% recoupled.
- Slaughter premium - 40 % recoupled.
- Calf slaughter premium - 100 % recoupled.
- Sheep and Goats - 50 % recoupled.
- These come into place in 2005.

The exception is for dairy cattle where the process starts this year with a cut in the European market support prices, and a fully decoupling fixed premium per 1000 litres of quota (calculated at the average milk quota between 2000-2002) of €11.88/1000 litres.

Cross compliance starts in 2005 with controls on just 3 of the 19 European Directives in the first year: these are the Birds and Natural Habitats 2000 Directive, the Nitrate and Underground Water Directive, and the Cattle Identification Directive. In the second year Directives governing pesticides and public health will be added, and in 2007 the Directive on animal welfare comes into force. These are the special touches, and there are a lot of them, so we do not expect a simple life.

As the Single Farm Payment (SFP) is attached to the land, this means we have to keep the same ratio of premium per ha on the farm,

- To avoid speculation on the SFP.
- To control the transfer of SFP.
- To keep the SFP located in specific regions and areas.

For example:

- It will be impossible to transfer SFP if the right has been 80% used at least once.
- Any SFP rights unused for 3 years go to the reserve.
- It is impossible to transfer the SFP rights on land coming from the reserve for a 5 year period.

The cross compliance conditions means that “good environmental conditions” have to be fixed in each country. In France, 3% of the total of the surface of cereals must be in grassland and if there are waterways there must be 5 m. of grass along the edge of any water. The 3% must be included in the set-a-side area.

The taste - what do French farmers think of it?

Like a typically French complex dish there is a mixture of different tastes: the bitter:

- The cost of obtaining public money is high: some cross compliances will be very difficult for some farmers to respect - especially by the oldest and the smallest farmers.
- The modulation of 3% in 2005, 4 % in 2006, and 5 % in 2007 on European Payments above €5000 on the first pillar is tough.
- This reform is political and does not meet with farmers’ objectives. The farmers’ union is very much against it.
- That farmers are no longer being paid to be producers is a major cultural change.
- In the case of the animal welfare and the nitrate compliances the cost of investments will be too high for a lot of cattle farmers.
- Additional reporting restrictions will generate more paperwork, and in general farmers do not welcome additional paperworker!

And the sweet:

- The French system of keeping a certain amount of coupling will maintain farming activities in almost all the different regions despite their level of potential.
- Modulation (80% of the French levy will return to France) will go to rural development - which means it will mainly go to the cattle areas in France.
- SFP can be sold and bought - but with highly administrative and complicated systems. For example the trade of SFPs must be in the same Department (region). In the case of a sale of SFP without the land, a levy of 50% of the SFP will be deducted, and in the case of a sale with the land, the levy will be 3%, 5%, or 10 % depending on the size of the buyer!!
- We are moving towards meeting the needs of the WTO negotiations, and to stabilising the European support for agriculture.
- The new system will be clearer for the consumer - sorry - the tax payer. He will know what he is paying for, which will include food products produced with techniques that are more in tune with nature.
- The rules on set a side are more flexible – for example the 5 m of grass along the river.

Impact and future

The total of the public support I receive on my farm is shown in Table 1. This is roughly the net income for two people.

Table 1. Direct payments received on my farm.

	2003	2004	SFP 2006 "recoupling"			
Slaughter premium	€1 943	12C-3H-4K C=cow H=heifer K=Calf €1 836	60%=>C:48*12 100%=>H:61,5*3 0%=>K:0 €760	40%=>C:32*12 0%=>K:50*4 €584		
LFA	€12 852	136 4/ha €14 137		€14 137		
Cereals	€7 650	346.6 €/ha €7 800	75%	€5 737	25%	€1 912
Grassland	€6 500	76.23 €/ha €6 440		€6 440		
Milk quota premium		11.88 €/t €4 180	35,5 €/t	€12 531		
Total	€28 945	€34 393	€21 523 - €576 + €14 137 = (21 523 - 10 000 - 5%) €41 524			

Amongst these figures the most important for us is the dairy premium. Fully decoupled on historical quota reference - from 2003 until 2006 we will receive €12,531 minus €576 of modulation - so that is roughly €12,000, divided by 350,000 litres milk at €0.312/lt, which is equal to 11% of the milk income. So the compensation will be enough to cover a fall of 11% of the milk price. As we are located in a less favoured area, we hope to have some extra returns on the second pillar but nothing sure at this time. The decoupling on 75% on the arable area will encourage us to change the maize silage area to grass silage - as we don't have a very good yield of maize, weed control without atrazine is more difficult and more costly, and grass is easier to grow. So with maize's SFP compared to that of grass, the French Agronomic Research showed that the net income could grow from €1 to €7 per 1000 l of milk. If we do replace the maize with grass, it will be much easier to change the entire farm to be organic. Using the compost we produce on our platform it

Table 2. Average milk quota per farm (litres) for selected EU countries and across EU 15.

Country	1995/96	2002/03	Change
Germany	147 300	219 600	+72 600
France	150 700	197 100	+46 400
UK	349 700	603 200	+253 500
The Netherlands	261 800	410 800	+149 000
Denmark	301 000	536 700	+235 700
Ireland	125 400	196 500	+71 100
Italy	89 800	176 200	+86 700
Spain	42 800	129 200	+86 400
EU 15	120 300	204 300	+84 000

Source. EU Commission (2004)

would be simple to grow organic grass. The major problem however is that our cows are kept on slats during the winter and this is forbidden for organic dairying in France. So we will have to study this opportunity a bit further. In any case the compost diversification is still a good option for us. Society's concern about recycling waste will grow in the future, so this business must be more attractive and more profitable in the long term.

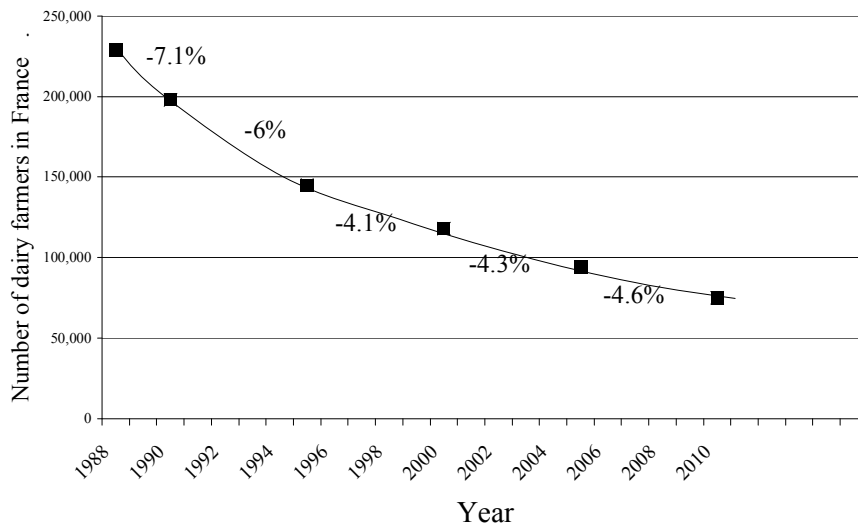
For the French farming industry

Will the changes be too big? During past reforms of the CAP: for example the 1992 review and when milk quota was imposed, many dairy farmers survived even though they were very unhappy and concerned by these changes. Table 2 shows that the impact of quotas on farm size has not been the same for different EU member states. The growth of the dairy farm size in the UK was 72%, and 78% for Denmark but only 30% growth for France.

Table 3. Income and dairy farm structure in Europe.

	France	Germany	Ireland	Holland	Denmark
Production in kg/ farm	205 000	213 000	173 000	407 000	407 000
Unit of full time (UTA)	1.73	2.06	1.58	1.63	1.74
Yield/UTA in kg	118 500	103 000	109 500	250 000	234 000
Gross income/ farm in €	48 400	48 000	30 200	78 400	75 700
Gross income/ FamilyUTA (€)	29 900	31 800	21 600	50 600	63 100
Net income/ Family UTA (€)	17 400	15 100	17 300	16 000	17 000

Figure 1. Number of dairy farms in France



2. I do not have the UK figures, but they are very similar to those of Denmark in terms of unit size

Table 3 compares the net income per unit of family members working on the farms. It can be seen that they are similar.² There is very little difference between the European countries despite the different approaches taken towards the management of milk quotas.

Despite these reforms, the milk price will not necessarily fall. But there will be regions where milk can not be collected any more and we do not yet know what the regional political reaction to maintaining farmers and real activities in the rural areas will be. For example in my own region, several town councils and districts have already financed, with public funds, brand new dairy units for young farmers, and in 15 years time after paying a little rent the farmers will become the owners of the farms. In my view, it is crucial to maintain farming activities in the countryside, especially near to towns.

We know that before the reform we had already lost a number of farmers, and we know this trend will continue (Figure 1). Following this reform this trend will carry on and the projections show that we will be reduced to only 75,000 dairy farmers in France by 2010, with an average quota of 300,000 litres/farm, which will mean a 4.6 % drop in the number of dairy farms per year.

I am not convinced that to be bigger will be the best or the only solution. If the farm is not efficient then controlling all costs (fixed and variable) will be a priority if the farm is to survive. However, it is true that more land with the SFP, if this does not mean high additional investments, could increase the net income.

If we look at the impact of market regulation on production, decoupling and the SFP must give more flexibility to the industry, and each farmer will be able to adapt their business to the best solution for them. This is perhaps, not 100% true because farming is a heavy industry with a lot of capital invested, with long-term returns, so it is difficult to make a one hundred and eighty degree turn especially given the higher market risks. For example, in France more than half of all organic milk is being sold as conventional milk. So these reforms will make us consider the market for our produce, and we will need to anticipate market reaction to a much greater degree than we did in the past.

What about intensification?

I do not think these reforms will necessarily require a change to the farm manager's thinking about intensification. Managers will still need to assess opportunities in relation to the climate, the soil, the buildings, the market demand, and available labour etc. (i.e. to their particular circumstances). As a result of the new regulations we may need to become more or less intensive. As before, we will need to respond appropriately to any new regulations. These may require further large or small changes, and these decisions may be difficult or easy to make.

So, these reforms means we now have a different policy environment to work in, the business parameters have effectively changed, and for some these changes could open up new opportunities. For example, we are considering switching to organic production. In areas where much maize and cereals are grown the 75% decoupling of the SFP on arable land may allow some farmers

to achieve a better margin by growing more grass and less maize and cereals. In our farm situation the figures showed that we could have between €1 and €7 increase per tonne of milk produced by increasing the area of grass area at the expense of less maize, but this will mean that our soil will need to be sufficiently productive to be able to grow enough grass to meet our grazing and harvesting requirements.

Conclusion

There will be two options with which to face these challenges, we can be passive or proactive. The management challenge is to adapt each system to achieve the best solution, there are no unique solutions to success. The MTR is not the only issue that will influence the future. I believe that some farmers will enjoy the 'menu' and will be very happy at the end of the 'meal', but some others will finish hungry because they do not like the 'dishes', and will perhaps be angry at the end. As I am talking to the best farm managers and farm consultants in this country, I am very confident that you all know what our job is as managers, how to work with the best experts to address problems. Do not be afraid of this new reform of the CAP, just be attentive and informed with an aim to make good decisions at the right time. And finally back to our 'French cuisine': a good recipe, good ingredients bought in a good market, with good kitchen utensils, a good oven, are not enough to have "un bon repas" *we also need a good chef to do it.*

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European Commission (2004) French cattle institute. EU Commission.

Biographical Notes

Michal Pivard is a fourth generation farmer farming in Dortan, East France. He graduated from agricultural college with a degree in General Agriculture and then specialised for 2 years in Animal production. He currently farms with his twin brother. He has been very involved in the farming organisations throughout his life. Initially as general secretary for four years in the young farmers association, he became a member of the local chamber of agriculture in 1983 and from 1989 has been its General Secretary with responsibilities for training activity. He has been chairman of the Milk Record and Advisory Services Association in the department of AIN since 1991, and a member of the National Board of the Milk Record Associations since 1994, being elected its vice-chairman in 1999. He is also the chairman of two computer companies, CMRE Coop and CMRE Logiciel. He was a Nuffield Scholar in 1989 studying training and advisory services for UK farmers, and in 2004 took part in the Leadership Development Programme of the Institute of Agricultural Management.

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EDITORIAL

In the first paper of this issue James Jones discusses the importance of cost structure on farmers' production decisions, a particularly relevant issue following the introduction of the Single Payment Scheme (SPS). Farmers who have invested in machinery and/or directly employ farm workers have larger financial commitments than those who exclusively use contractors. Contractor costs can be saved when land is withdrawn from production for a year or two, where depreciation and labour costs continue to be incurred. Jones discusses the relationship between flexible costs and yields to argue that the more flexible fixed costs are the more savings can be identified if land is not cropped, and so the higher the market price needs to be *ceteris paribus* for the farmer to crop the land.

Managing technological change is an important part of managing farm businesses. David Telford and colleagues present findings from a survey of suckler beef farmers' intentions and attitudes towards using sexed semen from beef bulls: an interesting question given that the product is not yet commercially available. Their findings show the largest constraints to beef sex semen use are the practical difficulties associated with using artificial insemination. That very few farmers had a principled objection to using sexed semen shows they welcomed a product that has the potential to revolutionise beef farming world-wide.

Every two years the Institute invites a younger member to present the Middleton Memorial Lecture. Sharon Byles accepted the invitation and her paper about continuing professional development (CPD) in farming is presented here. She outlines some of the many methodological problems associated with defining and measuring CPD and in assessing its effectiveness. The paper reviews the reasons why farmers enrol on CPD training programmes and argues that the measures used to assess effectiveness must reflect farmers' motivations to enrol on the programmes.

The following article introduces the UK's Rural Economy and Land Use (RELU) programme. It summarises the research funded in its first funding round – there will be at least two further funding rounds. Many of these studies examine some aspect of land management and as RELU is “policy relevant but not policy driven” it is expected they will deliver a flow of policy recommendations which will influence future land use and farming practices. The Editorial Committee welcomes articles from these studies which demonstrate that the likely consequences of the policy recommendations on farming practices and farm livelihoods have been given full consideration.

The final paper of this issue starts this dialogue; Mark Tinsley gave his views on the future of UK agriculture to researchers who won funding in the first round of the RELU programme; we are pleased the Journal can present his views to a wider audience.

Jeremy Franks

‘TO PRODUCE OR NOT TO PRODUCE?’ - IS THAT THE QUESTION?

James Jones

The decoupling of subsidies leaves farmers in the UK virtually entirely reliant on market returns to justify production. At the same time factor costs are rising. Studies of the impact of decoupling predict that few farmers will take land out of production. However this paper argues that this may be justified especially when significant fixed cost savings can be made in doing so. This assertion is demonstrated by testing the sensitivity of planning decisions to expected yields and prices under four business scenarios each of which has a different overhead cost structure.

Key words: decoupling, margins, cross compliance, viability, production costs.

Why should the question arise at the present time?

There is nothing new in farmers facing production decisions that might involve taking land out of production. What makes this issue particularly relevant at the present time is the decoupling of agricultural support from production under the reform of the Common Agricultural Policy (CAP). Whilst funding is not going to be removed entirely, it will lose its link to production activities. What makes this a rather novel set of circumstances is that farmers will have to retain their land if they want to receive the new Single Payment (SP). If the subsidy were to be removed entirely one might expect a large-scale restructuring with land sales and rents reflecting the reduced profitability as a result of subsidy withdrawal. As it is farmers can still expect to receive an income from their land even if it is withdrawn from production. In a sense this option has faced arable farmers since the introduction of set aside. But it is now available to virtually all farmers for the whole farm. It also comes at a time when there have been sharp rises in factor costs – notably those linked to oil prices.

This article explores the extent to which land is expected to be withdrawn from production based on modelling undertaken for policy determination at EU and UK level. It then explores a logical approach for individual producers to examine, within the framework of the SP scheme requirements and the cost structure of their own business, whether to contemplate a partial or complete withdrawal from production. This will obviously be determined by the extent to which production returns can be maximised on the one hand and what alternative uses exist for resources that are released by ceasing production on the other. Finally the article seeks to explore the influence of individual cost structures in determining the sensitivity to price changes of the decision to produce or not. This is illustrated by comparing the situation of combinable crop farms that rely heavily on contractors (and therefore have some flexibility in saving costs should cropping cease) with the typical family run farm where the scope for cost savings is likely to be much less.

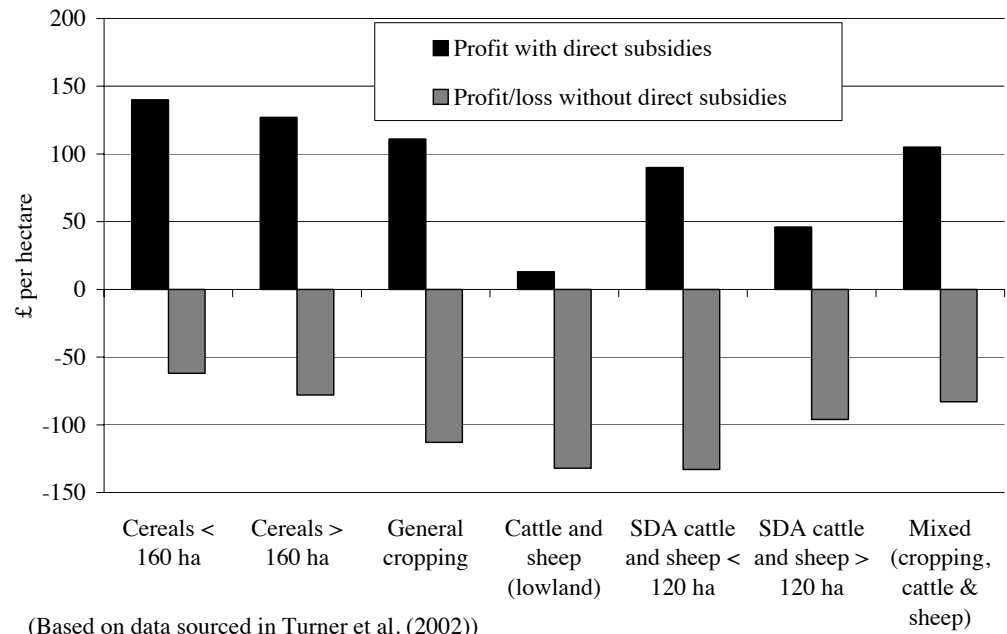
The effect on profitability of decoupling subsidies from production

If we assume that the new SP is not specifically related to agriculture as a

production activity, we can see the effect that treating it separately might have on sector profitability by using the national accounting statistics. In 2003 Total Income from Farming (TIFF) in the UK was £3,197 million (DEFRA, 2004a; Table 2.1) and the amount spent on the direct subsidies that will no longer be paid after 1st January 2005 was about £2,225 million (based on DEFRA, 2004a; Table 10.1 with allowance for a continued area based supplementary payment on protein crops). So the direct subsidies represent about 70% of TIFF in aggregate.

Figure 1 explores the potential impact on farm incomes in sectors that have historically been the major recipients of direct payments – combinable crops, beef and sheep. The figures used (from the RICS Farm Benchmarking Manual) are based on Farm Business Survey data (Turner *et al.* 2002). They show that, all else remaining unchanged, removing production-linked direct subsidies turns profits into significant losses across a whole range of farm sizes and types in both lowlands and uplands. It should be noted that the calculation is based on actual direct subsidy receipts and therefore takes no account of the prospective changes in sugar beet support that would further affect intensive arable farms. The assumptions and the effects are described more fully in GFA RACE (2002).

Figure 1 The impact of direct subsidy removal on the profit per hectare of a range of farm types and sizes



The evidence in Figure 1 might suggest a need for major restructuring of production across major sections of the industry. In terms of pure economics

this situation looks unsustainable. This might at least be the short-term reaction. As Crammer *et al.* (2001: p.147) put it, ‘the first temptation might be to say “quit” maybe hoping that market conditions will improve later’. The ability to generate an income whilst waiting for this up-turn is of course enhanced by continuing to receive the SP subsidy. In fact, studies conducted on behalf of the EU Commission and the UK government suggest relatively slight structural readjustment and with very little land being taken out of production.

Studies of the impact of decoupling

At the EU level

The major work was actually a collection of studies (EU Commission 2003a) based on modelling undertaken by the Commission themselves and models developed by various university based economists (FAPRI, CAPRI and CAPSIM). The impact analysis undertaken in January 2003 was revised and summarised in a report in March 2003 (EU Commission 2003b). However the models did not account for the changes incorporated into the final agreement (which notably included partial decoupling). The models used were not static. They took into account market movements that partially compensate supply reduction with increases in price that then affect the incentive to cut back production.

The results showed a 2.6% reduction in the area of cereals but that ‘most of the fall in cereal area would come from the new competition from energy crops, with the cut in cereal price support and the introduction of decoupling having a minor effect’ (EU Commission, 2003b: p. 6). Nevertheless the modelling assumed an increase in ‘voluntary set aside’ of between 28.8% and 38.8% of the baseline in the period up to 2009/10. But still this area only comprised about 3 million hectares in comparison to about 40 million hectares of cereals and oilseeds. Reductions in livestock numbers were predicted. Suckler cow numbers were projected to fall by 14% resulting in a reduction in total cow numbers of 3.5% by 2009 (EU Commission, 2003b: p. 8). The summary did not mention the sheep sector but earlier studies suggested decreases on a smaller scale to the beef sector. So the net result appears to be a lower intensity of utilisation of grassland even though there was no prediction on the area of grassland that may be ‘abandoned’.

At the UK level

DEFRA commissioned a number of studies in 2003 to look at decoupling effects both in aggregate and by sector (Moss *et al.* 2002; ADAS 2002; CRER 2003; Revel and Oglethorpe 2003) as well as a study of the potential environmental impact, which was up-dated as the ground rules for the reform were changed (GFA RACE 2002). The overall conclusions of the commissioned studies were summarised by DEFRA (2003).

The arable study (CRER 2003) showed the changes in the area of set aside/fallow reproduced in Table 1. In most cases the area increases, although

Table 1. The predicted change in land devoted to set aside (i.e. fallow) in the short term as a response to the CAP reform across a range of arable farm types.

Farm Type	Size in hectares	% change
Small cereal farm	67	+74%
Average size cereal farm	280	+10%
Large cereal farm	662	+9%
Cereals with sugar beet	257	-9%
Cereals with potatoes	257	-10%
Cereals with grass	193	0
Cereals with high Net Farm Income	192	+10%
Cereals with low Net Farm Income	213	+5%

Source: CRFR (2003)

the more intensive farm types actually showed a reduction in the unfarmed area. It should be pointed out though that these models were based on an earlier version of the proposed Mid Term Review, for example, when the reforms were assumed to allocate subsidy on the historic basis only and did not include the so-called 'negative list' authorisations for growing potatoes and vegetables (although this probably would not have altered the results much). The percentages were generally somewhat lower than those predicted in EU wide studies.

Livestock studies showed decreases in the number of suckler beef cows and to a lesser extent breeding sheep. The ADAS (2002) study highlighted a greater likelihood of a dramatic response in the hills, especially on larger farms. None of the studies were precise on potential abandonment of grassland suggesting only that stocking rates would decrease.

The Centre for Rural Economics Research at Cambridge University have more recently made long term 'business as usual' (BAU) projections of agricultural land use and stocking to 2015 (CRER, 2004). This work was conducted for the Environment Agency (in order to evaluate the implementation of the Water Framework Directive) and factors in the impact of CAP reform. The study assumed that by 2015 set aside, as a formal requirement, would have disappeared. This represented a potential 518,260 hectares coming back into production in England. However an estimated 129,565 hectares would still be uncropped under this scenario. A reduction in the area of grass of 135,857 hectares was predicted. Dairy cows numbers were expected to decrease by 292,431 head, suckler cows by 99,812 and breeding sheep by 439,768. Woodland was projected to increase in area by 46,558 hectares. Overall a reduction in the agricultural area of 273,900 hectares was envisaged. (CRER 2004; Tables 14 and 15: p. 49-51).

Responsiveness to the impact of decoupling of subsidies

It is clear from the indicative industry costings in Figure 1 that farms in the

beef, sheep and combinable crop sectors will struggle to make a profit without direct subsidies. On the other hand the studies of CAP reform impact do not, at least in land use terms, suggest a large scale withdrawal from production. On the face of it these two observations might be hard to reconcile. However there are broadly three hypotheses that may explain this:

- Farmers will continue to produce even though all their costs are not fully met (using their SP and/or other sources of income to cross-subsidise the loss making activity).
- Performance increases (due to improvements in physical output, price and cost of production) will allow at least a small profit to be made.
- Cross compliance conditions attached to the SP will make it too difficult to take land out of production and continue to benefit from the subsidy.

Obviously these are not mutually exclusive explanations.

Using the Single Payment and other income to offset loss-making production activities.

Farmers have business objectives other than just profitability, and their behaviour often departs from what might seem rational and logical based on profit maximisation alone. Subsidy allocation will be different post CAP reform, particularly in England where it will be on a flat rate 'regional average' basis and there are subsidy gainers and losers (as explored in Jones (2004)). But typically sufficient SP will be received by the farms (depicted in Figure 1) to achieve a level of income not far below that achieved before decoupling (DEFRA 2004c). It is likely therefore to be a viable option for farms, at least in the medium-term, to ignore the implications of decoupling.

It is also important to bear in mind that if farmers cease production they may not avoid all costs especially considering the fact that they have to retain their land in order to claim the SP. That will not allow them to sustain losses indefinitely should the SP fail to make up the difference, but it will help to justify maintaining production even though not all costs are being met. The key issue is whether production revenue at least covers those elements of the costs that would be saved if production stopped. This is explored in more detail below.

Improving performance

It is reasonable to expect some increases in performance. Prices are expected to rise in most of the affected sectors. This is made most clear in the work by Moss *et al.* (2002) and further confirmed by more up-to-date modelling predictions (Moss *et al.* 2005). Whilst this may be true in bulk commodity markets, there may also be additional price improvement due to the efforts of farmers to achieve better prices by addressing marketing issues. This might be possible by large-scale concerted action in bulk commodity

markets but it is more likely to be achieved in niche markets.

There is also a likelihood that changes will take place in physical performance and costs as a result of those with low performance or high costs making way for those better able to compete. This may not be as simple as the weaker performers giving up their land. It may be that they enter arrangements with other farmers reducing their self-reliance but at the same time lowering their own costs. The existence of the SP creates a significant incentive to existing farmers to be, at least technically, still in occupation and control of their land in order to receive the payment.

There is however an irony in the conclusion that to reduce costs farmers may resort to a greater extent on 'outsourcing' labour and machinery by use of contractors, casual labour, machinery rings etc. Doing so will not just affect the *level* of costs but also their *nature* - making them less fixed and more variable or 'discretionary'. Farmers with largely discretionary fixed costs can then selectively choose not to produce and achieve a substantial reduction in costs compared to farmers who have a fixed overhead cost structure (which can only be substantially reduced by radical change or by lowering the opportunity costs of the resources used). This notion is explored in more detail later. It may be that the impact models reviewed above have not factored in the extent to which the industry might restructure its costs in this way; a response which would allow it to react differently to price movements and other economic influences (i.e. generate a new supply response).

Meeting cross-compliance requirements

The main element of cross compliance (as it applies in England) that affects taking land out of production is 'GAEC 12 - Eligible land which is not in agricultural production' (DEFRA 2005: p. 19-21). The main stipulation here is that 'you should not allow thick scrub to develop, and should take action to prevent the spread of weeds (as listed in GAEC 11)' and to cut or graze the land at least once every five years. In the Regulatory Impact Assessment (RIA) it was assumed that 'The level of management required is not very onerous', (DEFRA 2004b: p. 49). 'Overall costs would not be expected to be substantial...' and 'Where they occur they would tend to be greater on arable or mixed farms'. (DEFRA 2004b: p.50). The report estimates the cost of initial establishment of green cover at £50/ha. But this does not need to be renewed and so the costs can be spread over several years. In any event natural regeneration is allowed so initial establishment may not be essential. It seems very unlikely that the costs of meeting cross-compliance requirements will act as a substantial barrier to taking land out of production, although Roche and Quinn (2004) implicitly disagree with this.

Measuring the costs and revenue implications of ceasing production

It is by no means easy to determine the extent of cost reductions by ceasing production. This is partly because the extent to which costs can be saved depends on the scale of the reduction. A small change (deciding to leave a corner of a field uncropped for instance) is unlikely to result in any significant reduction in the complement of machinery. In which case there will be no

Table 2. Elements of 'fixed' or 'overhead' costs that might change with withdrawing land from production but maintaining it in good agricultural and environmental condition

Cost item	Cost savings from a partial or short-term cut in production	Cost savings from a complete or long term reduction in production.	Costs which are likely to be substantially unaffected
Labour	<i>Casual and possibly some part-time labour cost</i>	<i>Regular labour and probably also salaried management</i>	<i>Family labour (although it depends on the situation)</i>
Contract and machinery hire	<i>All production related</i>	<i>All production related</i>	<i>Related to maintenance only</i>
Machinery depreciation	<i>Minimal</i>	<i>Significant on all production related equipment</i>	<i>Basic farm transport, just related to maintenance and all plant (until written off)</i>
Machinery repairs	<i>Significant – pro rata with use</i>	<i>Very large</i>	<i>Farm transport and maintenance only</i>
Fuel and oil	<i>Large – pro rata to use (including drying)</i>	<i>Large – pro rata to use (including drying)</i>	<i>Farm transport and maintenance only</i>
Water and electricity	<i>Large - pro rata with consumption</i>	<i>Large – pro rata with consumption</i>	<i>Minimal unless attributable to another business activity</i>
Property maintenance	<i>Almost none</i>	<i>Small – just that arising from less 'wear and tear'</i>	<i>Basic upkeep</i>
Fixes capital depreciation	<i>None</i>	<i>None until written off</i>	<i>Depreciation on past expenditure</i>
Rent	<i>None</i>	<i>None</i>	<i>Unaffected</i>
Insurance	<i>Very little</i>	<i>Significant – removal of farming risks</i>	<i>Buildings, third party risk, remaining machinery</i>
Professional fees, secretarial and office expenses	<i>Little or none</i>	<i>Removal of production related including agronomy, performance related. Etc</i>	<i>Basic accounting, tax advice, subsidy claims administration etc.</i>
Transport, market tolls etc.	<i>Pro rata but economies of scale may make this quite marginal</i>	<i>Almost entirely removed</i>	<i>Virtually none</i>
Others e.g. training, travel	<i>None</i>	<i>Significant</i>	<i>Discretionary – small requirement</i>
Bank charges and interest.	<i>Quite small</i>	<i>Very significant</i>	<i>Core debt servicing and medium/long term loans</i>

saving in capital tied up in machinery and very little impact on depreciation. However there will be savings to be made in costs related directly to use such as tractor fuel. On the other hand a substantial reduction in the area in production might trigger a complete move away from reliance on the farm's

own machinery. In which case the scale of savings is obviously much more extensive. Table 2 Explores this issue in a qualitative sense for a range of inputs commonly classified as overhead or fixed costs.

There are obviously plenty of issues concerning the problems of cost allocation and the difference between fixed, integer and variable costs. There are also the complexities of complementary and supplementary relationships in resource use between enterprises to consider. It also needs to be possible to factor in the consequences on the output from subsequent cropping of taking land temporarily out of production. Will wheat grown after a fallow give the same sort of net margin as wheat grown after oilseed rape or peas? These effects are subtle and difficult to measure but they are nothing new and apply within any mixed farming system. However this is basic farm management economics which is covered fully by undergraduate textbooks (such as Turner and Taylor 1999) and does not require detailed further explanation (although some might disagree (Malcolm 2004)). It can be argued though that decoupling subsidies from production activities does make it *more* necessary to take a closer look at costs associated than before. In doing so there may be some merit in reopening the case for the use of net margins which attempts to allocate some of the overhead costs (as advocated by Giles 1986; 1987). But there is certainly a need to refine the methodology (as pointed out in Kerr 1988) for this to be more practicable and useful.

The problems are not merely ones of cost allocation.

Exploring the implications of differing cost structures on the incentive to take land out of production within a combinable crop rotation

Combinable crops provide a good opportunity to explore the boundaries of the viability of production under different overhead cost structures. This is because it is quite possible to apply a more flexible approach to labour and machinery resourcing by use of contractors and to stop and start production without huge consequences either logistically, agronomically or financially. This is not the case with breeding livestock, for example, where it might be easy enough to stop production but much harder to reintroduce it without then having to tackle problems of disease, a lack of breeding records, etc.

Let us assume that there are three major variables that will affect the viability of combinable crop production post decoupling. These are grain yield, grain price and production costs. This places no value on straw, which simplifies the situation and is a realistic assumption for many cereal farmers. In practice, the main direct material costs of production - seed, fertiliser and spray chemicals can and do vary from industry norms. So let us also assume a standard level of variable costs (regardless of the yield outcome) based on assumptions in Nix (2004). So the greatest cost variability is in the 'operational' side, i.e. the costs of cultivation, managing the growing crop and harvesting it (i.e. largely so-called 'fixed costs').

Table 3 below offers four production scenarios which extend from maximum operational cost flexibility, where all labour and machinery and grain drying are out-sourced to the typical industry norm (based on Turner *et al.* 2002) where a self-sufficient approach is adopted, the use of contractors is fairly light and grain is dried and stored on farm. There are two further

Table 3. Net marginal cost savings made by taking land out of cropping under four different overhead cost scenarios

	Entirely by contractor External grain store		Entirely by contractor Own grain store		Mostly by contractor		Typical family farm (marginal costs only)	
	£/ha	% change	£/ha	% change	£/ha	% change		% change
Paid labour					£5	-22%	£8	-19%
Casual labour							£4	-100%
Machinery repairs					£15	-68%	£34	-83%
Fuel and oil					£9	-82%	£25	-86%
Contract charges	£218	-93%	£218	-93%	£165	-100%	£31	-100%
Electricity					£4	-100%	£4	-80%
Sundries	£5	20%	£5	20%	£20	-27%	£6	-17%
Overdraft interest	£19	100%	£19	100%	£19	-126%	£15	-107%
Total	£242		£242		£237		£127	
	£/tonne		£/tonne					
Grain drying	£6.90 - £8.20		£2.50 - £3.50					

Sources. Proctor (2004), Contractor and Large Scale Farmer (2004),Lang (2004) and Turner *et al.* (2004)

scenarios that lie between these extremes. One where all operations are undertaken by contractors but the farm has its own grain storage facilities so the potential costs that can be saved on grain cleaning and drying are only the running costs. The other is based on a sub-sample of farms within the Eastern Counties Farm Business Survey which have a particularly high use of contractors (the ‘Mainly Contractors’ category in Lang (2004) Table 7.10: p. 69).

The costs presented in Table 3 are only the marginal overhead costs, i.e. those that change as a result of taking land out of production on a small-scale and in the short-term. They do however, include the cost of allowing for maintenance whilst the land is out of production so that it meets cross compliance requirements.

The marginal net overhead cost savings can then be combined with the variable costs from forecast gross margins for 2005 (from Nix, 2004) to give an overall cost saving from a temporary withdrawal from production. In doing so overhead costs have been allocated evenly across enterprises. This does treat each crop as being equal in overhead cost requirement on a per hectare basis which is an oversimplification but probably not a gross one.

In order to demonstrate the sensitivities to price and yield assumptions however we need to present the break-even production cost in the form of a cost per tonne at a given yield level. Three different yield levels have been used, described as 'low', 'average' and 'high' by Nix (2004) for the range of crops under consideration (the actual yields - in tonnes per hectare - are given in Table 4).

Table 4. High, average and low yield levels used in the cost of production calculations

	Low	Average	High
	t/ha	t/ha	t/ha
Winter wheat (feed)	6.75	8.25	9.75
Spring wheat (milling)	4.75	5.75	6.75
Winter barley (feed)	5.25	6.50	7.75
Spring barley (malting)	4.10	5.00	5.90
Winter oilseed rape	2.50	3.25	4.00
Linseed	1.00	1.40	1.80
Winter beans	3.00	3.75	4.50
Peas	3.00	3.75	4.50

Source: Nix (2004)

The overhead costs of remaining in production expressed per tonne of output at each of the three different yields for all four production scenarios are shown in Table 5. It should be noted that the data for peas and beans include a £35/ha subsidy that is still coupled to production. The net cost of remaining in production in effect sets a break-even point or price target at the three different yield levels that has to be met or exceeded. What this shows is that there is a considerable range in outcomes dependent on the extent of potential overhead cost savings and expected yields. Feed wheat, for example, has a break-even price threshold of only £38/tonne for the family farmer on high yielding ground. However on the same farm but managed by contractors and without any grain storage the farmer would have an incentive to quit production at £57/tonne or less and under a low yield scenario at £79/tonne or less.

Table 5 also shows the range of profit/loss per tonne at low and high yields, based on the prices assumed in Nix for 2005. This shows that for a farm run entirely by 'contractors with no on-farm grain storage' only winter oilseed rape and winter wheat grown with high yields are profitable. In low yield situations only the 'typical family farm' shows a profit by staying in production, and then only when growing wheat and beans. Obviously there will be some complementarity between enterprises in what yields can be achieved. But break crops will need to create significant benefits over fallow in order to be worthwhile on these grounds alone.

The knowledge of where break-even points lie will help farmers to make decisions based on expected yields and prices. This is especially important if

Table 5. Costs of production expressed per tonne of grain output at low average and high yield expectation compared with predicted prices for 2004/5

Entirely by contractor-external grain store.						
	Yield assumption			Price predicted	Profit range	
	Low	Average	High		Lowest	Highest
Winter wheat (feed)	£79	£66	£57	£65	-£14	£8
Spring wheat (milling)	£99	£83	£72	£72	-£27	£0
Winter barley (feed)	£93	£76	£65	£60	-£33	-£5
Spring barley (malting)	£105	£87	£75	£69	-£36	-£6
Winter oilseed rape	£194	£151	£124	£140	-£54	£16
Linseed	£374	£269	£211	£180	-£194	-£31
Winter beans	£119	£97	£82	£78	-£41	-£4
Peas	£139	£113	£95	£78	-£61	-£18

Entirely by contractor-own grain store						
	Yield Assumption			Price predicted	Profit range	
	Low	Average	High		Lowest	Highest
Winter wheat (feed)	£75	£62	£52	£65	-£10	£13
Spring wheat (milling)	£95	£79	£67	£72	-£23	£4
Winter barley (feed)	£89	£72	£61	£60	-£29	-£1
Spring barley (malting)	£101	£83	£71	£69	-32£	-£2
Winter oilseed rape	£190	£147	£120	£140	-£50	£20
Linseed	£370	£265	£207	£180	-£190	-£27
Winter beans	£114	£92	£77	£78	-£37	£0
Peas	£134	£108	£91	£78	-£57	-£13

Mostly by contractor						
	Yield assumption			Price predicted	Profit range	
	Low	Average	High		Lowest	Highest
Winter wheat (feed)	£71	£58	£49	£65	-£6	£16
Spring wheat (milling)	£91	£75	£64	£72	-£19	£8
Winter barley (feed)	£85	£69	£58	£60	-£25	£2
Spring barley (malting)	£97	£79	£67	£69	-£28	£2
Winter oilseed rape	£185	£142	£116	£140	-£45	£25
Linseed	£362	£259	£201	£180	-£182	-£21
Winter beans	£109	£87	£73	£78	-£32	£5
Peas	£129	£103	£86	£78	-£52	-£9

Typical family farm-marginal costs only						
	Yield assumption			Price predicted	Profit range	
	Low	Average	High		Lowest	Highest
Winter wheat (feed)	£55	£45	£38	£65	£10	£27
Spring wheat (milling)	£68	£56	£48	£72	£4	£24
Winter barley (feed)	£64	£52	£43	£60	-£4	£17
Spring barley (malting)	£70	£57	£49	£69	-£1	£20
Winter oilseed rape	£141	£108	£88	£140	-£1	£52
Linseed	£252	£180	£140	£180	-£72	£40
Winter beans	£72	£58	£48	£78	£5	£29
Peas	£92	£74	£62	£78	-£15	£16

prices are volatile and certainly this has been the case with cereal prices over the past three or four years.

Other factors that affect the balance of advantage as to whether to withdraw from production or not

There are some wider issues that need to be taken into account other than simply what the budgets indicate will be the financial advantage of withdrawing land from production. Some of these relate to the opportunity cost of capital and other resources. Other business activities are bound to have gained a relative advantage over agricultural production in competing for resources now that the subsidy link with production has been removed. Evidence from the CRR/RTRG (2003) study suggests that diversification away from agriculture is firmly on the increase anyway and that once established the scale and number of diversification activities tends to increase.

On the other hand the tax status of remaining in production is likely to be more beneficial. Where this can affect substantial liability for tax on capital assets this could have a big influence. But this is more likely to be a factor where a large proportion of the land is taken out of production permanently than where the withdrawal is small-scale and temporary – such as substituting fallow for a break crop.

Conclusions

The two major implications of the evidence presented in Table 5 are that:

- Having a flexible overhead structure does appear to give a much greater incentive to quit production, even under high yield and price levels, than might be the case on the typical family farm which has a relatively inflexible cost structure.
- Whilst the incentive for the typical family farm to withdraw from production is only significant at low prices and yields, at current prices it is hard to justify continued production under low yield conditions.

The first of these observations suggests that if the estimates of the extent to which farmers may take land out of production post-decoupling has not factored in a switch to more flexible overhead cost structures these estimates may be too conservative. Even a significant rise in prices post decoupling might not be enough to make farmers with a very flexible overhead cost structure want to consider some selective withdrawal from production.

The second observation suggests that all farmers should be looking closely at performance on a field by field basis. It may well be just as important to farm selectively as to farm on a large-scale in order to be cost competitive. It has tended to be taken too much for granted that the only means of achieving satisfactory profits has been to achieve economies of scale ignoring the diseconomies. This was easier to justify when every hectare was backed up by a production linked subsidy than it will be in the future.

The question of whether or not to produce in a world without coupled subsidies is a valid one. The answer may well be 'yes', especially for the

family farmer who is committed to farming as a way of life. But there is now a particularly strong incentive to examine costs and margins much more closely than was the case when quitting production meant losing the benefit of the subsidy. This is true even where the cost savings may be quite small - especially on poor quality land.

There is bound to be some inertia in taking such changes into account not least because subsidy still exists in the form of the SP. Nix (2004) observes that 'Despite the enormity of the change made in gross margins....the impact on production (areas planted and the number of livestock reared) could be quite small in 2005.' However he warns that 'They will almost certainly be greater in subsequent years' (Nix, 2004, p.15). Clearly we are destined to live in times which will reward flexibility in business planning and an awareness of marginal costs.

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Biographical Notes

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REFEREED PAPER

**QUANTIFYING POTENTIAL SEXED SEMEN USE WITHIN
UK SUCKLER BEEF ENTERPRISES**

Telford, D. J, Franks, J. R. and Beard, A.P.

Sexed semen from suckler beef breeds could soon be commercially available. This paper reports the responses of 483 suckler beef farmers regarding their intended use of such a product. A logit model is used to show that farmers with larger herds are more likely to use sexed semen, as are those who retain a larger percentage of heifers for replacements, those whose herd comprises cows bred from dairy and beef dams, and those who intend to increase the proportion of home bred replacements. Perceived major constraints to the use of sexed semen include less choice over bull selection, anticipated problems using AI and worries about lower conception rates. Farmers who believe sexed semen will be too expensive or would not generate a profit are less likely to use sexed semen. The logit model quantifies the impact on the use of sexed semen should these perceived problems be overcome.

Keywords: artificial insemination, beef cattle, farmers' perceptions, herd replacement policy, logit model, sexed semen, suckler beef systems.

Introduction

The primary product from suckler beef enterprises is calves. These are usually sold as suckled calves or store cattle for taking on to slaughter, or for breeding, although some are also retained on farm for finishing or breeding. Male and female calves have different uses and different economic values (Hohenboken, 1999) because of their relative biological efficiency and the support mechanisms in place at the time of the survey.

It is generally accepted that male beef animals are desired for the production of prime beef (Wise and Bobst, 1993) due to their higher carcass weights and better feed conversion during finishing (Steen, 1995). There is therefore an economic cost in producing females which are surplus to the need to maintain or expand the national breeding herd, and an economic gain if the necessary replacements can be bred from the best dams, since using semen from bulls of the highest genetic merit will also speed the rate of genetic gain. Thus the ability to select the sex of the offspring will reduce wastage all the way along the food chain, and improve the sustainability of beef production systems (Meat and Livestock Commission, 2000). These benefits suggest that pre-selection of sex is the most important development in reproductive technology since the introduction of commercial artificial insemination (AI) (Seidel, 2003). This paper reports the responses of 483 suckler beef farmers to their potential use of sexed semen.

At the time of the survey, the financial performance of suckler beef enterprises was underpinned by the payment of headage subsidies. In 2000, 45% of the value of total production of cattle and calves in England and Wales was derived from subsidies. Of those animals sold for prime beef, only male calves are eligible for the Beef Special Premium Scheme headage subsidy which could be claimed twice for each steer. The value of these payments was capitalised into the value of steer calves which gave them a market premium

over female calves. However, the subsidy arrangements under the Common Agricultural Policy have now been substantially overhauled in the new arrangements that have come into operation from January 1st 2005.

The survey was conducted whilst sexed semen from beef breeds was being trialled (Hall, 2002) with the expectation that it would soon become commercially available. Therefore this paper reports the findings of a survey into the intentions of suckler beef farmers' use of a product that was not currently available to them. Whilst models of technology uptake are regularly reported, it is unusual to model an event that has not taken place. These findings reflect farmers' perceptions of the technology which have been derived from articles in the farming press and reports of studies of sexed semen used in the dairy sector together with the farmers own reflective considerations of the potential impacts of the technology to their suckler beef enterprise. It is therefore to be expected that farmers' understanding of the performance of the sexed semen product is likely to be less fully formed than if the product was already in commercial use. Responses about the determinants of the adoption of this technology will help researchers to understand better the demand for the technology (Savage, 2001; Harper *et al.*, 1990; Sheikh *et al.*, 2003).

This approach gives advanced notification of farmers' perceptions of the benefits and problems of using sexed semen which should allow those developing the product to adjust their research profiles and publicity materials to address any perceived problems with the technology and in this way advance the processes of achieving effective technological transfer (Rama Rao *et al.*, 1997). This research into adoption intentions therefore provides information that should facilitate the practical adoption of sexed semen in UK farming systems.

The structure of the paper is as follows. Section 2 briefly discusses the characteristics of sexed semen technology and suckler beef farming systems in the UK to identify theoretical determinants of its use. Section 3 presents details of the survey and descriptive statistics of the participants. Section 4 introduces the logit model. Section 5 presents the results of the analysis and discusses their implications for the initial uptake of sexed semen. Section 6 concludes the paper.

Sexed semen and the determinants of adoption

In making decisions about adopting a new technology, farmers are assumed to examine the consequences of adoption of an innovation against its economic, social and technical feasibility within the context set by the behaviour and attitudes of those who might use it and the social context in which it may be used (Kebede *et al.*, 1990; Savage, 2001). Rogers (1995) suggests that the characteristics of an innovation which may affect its rate of adoption are relative advantage (e.g. economic, comfort, time and effort); compatibility with existing practices; values and beliefs; complexity (a negative relationship); trialability (the opportunity to test the technology before adoption or during a phased introduction); and observability (producing visible evidence of advantage).

A pre-requisite to the use of sexed semen is the use of artificial

insemination (AI), so early adopters are likely to be farmers who already use AI (McEvoy, 2000). For these farmers the skills needed to detect oestrus and to AI are already mastered, and the handling facilities to facilitate AI are in place. Moreover, the farming system has already been adapted to the technique. For those not using AI, acquiring this knowledge and skills, investing in handling facilities and making any farm system changes will be considerable barriers to the use of sexed semen. It is likely that these costs will be larger on extensive hill farms in Less Favoured Areas (LFA) where oestrus detection and stock handling are more difficult.

In the specific case of sexed semen technology, farmers' attitudes to reproductive strategy for their herd will also be important. Many suckler beef producers prefer to use a bull rather than use AI as this gives them a wider choice of bull types thereby allowing them to select the type that suites their own herd. This is especially valued in the industry because of the wide variation in the breed composition of suckler cow herds. Strategies for sourcing replacements also vary, but historically the majority of sucker cow replacements have been crossbred beef heifers from dairy herds. The supply of medium sized, well conformed beef x dairy suckler replacements is reducing because of the annual decline of the UK dairy herd of about 51,000 cows per year (Franks, 2001) and the wider use of Holstein sires in UK dairy herds (Simm, 1998). Sexed semen could allow farmers to produce more female replacements from the most desirable suckler cows within their own herd.

Farm size is generally shown to be a determinant of the uptake of new technologies. As sexed semen use involves a unit cost for each straw used, it could be argued that it is a "scale-neutral" technology. However, because sexed semen use requires mastery of AI, it may involve training costs and additional investment in cattle handling equipment; the higher these costs the larger will be the economies of scale associated with the technology thus favouring the larger enterprises which can spread fixed costs over more animals (Sheikh *et al.*, 2003). There may be other factors that relate to herd size that are not directly linked to the technical attributes of sexed semen which also influence its use, such as the farmer's financial security, overall business objectives and commitment to the future development of the enterprise.

Other aspects may influence the economic viability of sexed semen. Amann (1999) draws attention to three: the unit cost of sexed sperm, expected conception rate and the purity of the semen available. The Beltsville Sperm Sexing Technology uses flow cytometry to sort sperm based on the different DNA content of X and Y sperm (Maxwell *et al.* 2004). The rate of sorting is a major determinant of the sorting costs. Research into increasing the rate of sorting and developing deep uterine placement techniques outlined in Maxwell *et al.* (2004) are likely, if successful, to increase the uptake of sexed semen. At the present time, increasing the dose of sperm per insemination might increase conception rates but would also increase costs.

Farmer's technology choices are based on their subjective awareness of uncertainty (Feder *et al.*, 1985). As there is always some uncertainty involved with using a new technology, risk aversion will influence its use. With relatively little information about the parameters of sexed semen use available

for suckler beef enterprises, perceived risk is likely to be higher than if sexed semen was being used. In particular control of conception rates, which have been reported to be approximately 10% lower than with conventional semen (Rhodes, 2001), will be important.

The usual model for technological uptake involves early adopters developing a profitable system by trial and error before others take-up the by now tried and tested innovation. This survey was undertaken before farmers have had a chance to observe which farmers are using the innovative product, and before the outcome of that uptake is known. But there is no doubt that sexed semen could speed the process of specialisation of production systems, especially if its commercial availability was to coincide with the changes proposed under the Mid Term Review (EC, 2003). For example, it may provide the opportunity for top class herds to specialise in breeding heifers as replacement animals allowing other farms to aim to produce only steer calves (Hohenboken, 1999).

The survey

A postal questionnaire was used to collect data from a sample of suckler beef farms stratified by herd size category (0 to 30, 31 to 70 and above 70 cows), region (England, Northern Ireland, Scotland and Wales) and Less Favoured Area (LFA) status (inside or outside). Table 1 shows the structure of suckler beef production in the UK. A large proportion of suckler cows are concentrated in a relatively small number of herds. In total, 16% of herds are larger than 50 breeding cows and these herds account for 52% of all beef breeding cows. This distribution was reflected in the sample framework because the attitude and response of a farmer with a larger enterprise will have a greater impact on the number of sexed semen straws used than a farmer with a smaller herd: therefore, larger herds were over-sampled. A total of 1905 questionnaires were sent out resulting in 483 useable replies (25% response). The distribution of respondents by herd size is shown in Table 1, together with the number of cows in each herd size. Further details of the survey can be found in Telford *et al.*, (2003).

About 35% (171) of respondents said they would use sexed semen. Given the *a priori* expectations governing the factors that are likely to influence the use of sexed semen, all farmers were asked if they used AI in 2000, 25% (120) did. Therefore, the commercial availability of sexed semen would increase the number of farmers using AI by 40%. These summary statistics and others are presented in Table 2. Reasons given by farmers who do not intend to use sexed semen include the expected difficulties in using AI, low expectations of its profitability, and/or perceived problems with the technology itself, which included low conception rates and lack of choice of sire (from which sexed semen would be available).

The Logit Model

The decision to adopt a technology is a binary decision which can be represented as a qualitative variable whose range is limited to two values: 1 (adopt) or 0 (not adopt). Such adoption decisions can be analysed with binary

Table 1. The distribution of UK and respondents' suckler cows and suckler herds by herd size; June 2000.

Herd size	Suckler Herds			Suckler Cows		
	UK herds	% of UK herds	Respondent herds (and % of sample)	UK cows	% UK cows	Cows in respondents herds (and % of sample)
1<10	24 182	36.8	33 (7%)	112 373	6.1	170 (0%)
10<30	22 124	33.7	741 (5%)	405 101	22.1	1 446 (4%)
30<50	9 159	13.9	83 (17%)	353 449	19.3	3 263 (8%)
50<100	7 313	11.1	161(33%)	503 352	27.5	11 588 (29%)
>100	2 952	4.5	132 (27%)	456.353	24.9	23 671 (59%)(
Total	65 730		483 (100%)	1 830 628		40 138 (100%)

Source: Department of Agriculture and Rural Development Northern Ireland (DARDNI), (2001); Department for Environment, Food and Rural Affairs (DEFRA), (2001); Scottish Executive Environment and Rural Affairs Department (SEERAD), (2001).

Table 2. Summary statistics of respondents

	Respondents	% of total sample
<i>Responses from all farmers.</i>	168	100
Average forage area (ha).	154	32
LFA status: inside a severely disadvantaged area.	113	23
LFA status: inside a disadvantaged area.	216	45
LFA status: outside a LFA.	83	100
Average herd size (cows).	20	100
Average % of heifers currently reetaind for breeding.	144	30
Wants to increase proportion of home bred replacements.	96	20
About 50% of herd from dairy stock & 50% from beef stock.	277	57
Mainly spring/summer calving.	30	6
Mainly autumn/winter calving.	176	36
Split calving pattern (<60% in any one season).	120	25
Used AI in 2000	171	35
Intends to use sexed semen.		
N = 483		

choice models (Ayuk, 1997) which assume that individuals are faced with a choice between two alternatives (Pindyck and Rubinfeld, 1981). Generally, three types of models can be used to measure binary response behaviour; the linear probability, logit and probit models (Ayuk, 1997; Rama Rao *et al.*, 1997; Sheikh *et al.*, 2003). Ayuk (1997) states two disadvantages associated with the linear probability model; the predicted values may fall outside the 0-1 unit interval (Green and Ng'ong'ola, 1993) and the binary decision generates a non-linear response which violates the assumptions of the linear regression model (Sheikh *et al.*, 2003).

Logit and probit models overcome these problems as they are both based

on a cumulative distribution function, and use monotonic transformations that guarantee that the estimated probability lies within the unit interval (Ayuk, 1997). The models exhibit a sigmoid curve conforming to the theory of adoption (Sheikh *et al.*, 2003). The results produced by both models are similar, unless the samples are very large and many observations fall near the tails of the distribution (Maddala, 1983; Sheikh *et al.*, 2003). Therefore the choice between these two models is largely a question of convenience (Hanushek and Jackson, 1977). The logit model was selected because this has been the model of choice for many similar studies into technology adoption (Harper *et al.*, 1990; Kebede *et al.*, 1990; Green and Ng'ong'ola, 1993; Ayuk, 1997; Rama Rao *et al.*, 1997; Sheikh *et al.*, 2003; Herath and Takeya, 2003)). Further technical details of the logit model can be found in Appendix A.

Model results and discussion

Table 3 shows the variables selected on the basis of a maximum likelihood function. The log-likelihood ratio, which tests the hypothesis that the coefficients of all the explanatory variables are zero, has a χ^2 value of 457.015 ($P < 0.001$), suggesting that the estimated model is highly significant (Sheikh *et al.*, 2003). Unlike linear regression, the R^2 statistic cannot be computed exactly within logit models, so the Cox and Snell, Nagelkerke R^2 and Estrella (1998) approximations measure the proportion of the variation in the response explained by the model. These values are bound by the 0-1 interval with larger values indicating that more of the variation is explained. The respective values of these goodness of fit measures are 0.612, 0.841 and 0.8159, which all indicate a very satisfactory fit (Table 3). Table 4 shows that the percentage of farmers correctly predicted by the model was 94% (setting $Z_i^* > 0.5$), correct predictions are slightly higher for adopters (97%) than for non-adopters (92%).

Table 3. Logit model showing the determinants of the use of sexed semen.

Variable	Coefficient	Standard error	p-value	Marginal value*
Constant	0.239	0.364	0.511	0.006
Herd size	0.014	0.448	0.002	0.0004
Believed AI bulls will be inferior	-1.632	0.646	0.012	-0.025
Problems with AI	-7.55	1.18	<0.001	-0.331
Cost of sexed semen	-4.105	0.819	<0.001	-0.059
No profit in sexed semen	-4.391	0.889	<0.001	-0.057
Expect poor conception rate from sexed semen	-5.027	1.127	<0.001	-0.084
Wants to use more home bred replacements	1.53	0.538	0.004	0.056
About 50% of herd dairy stock and 50% suckler stock	1.081	0.599	0.071	0.0386
% of heifers currently retained for breeding	1.799	0.813	0.027	0.046

N=483

*marginal values are calculated at the sample mean.

Cox and Shell R^2 0.612; Nagelkerke R^2 = 0.841

Log likelihood = - 83.3958; restricted Log Likelihood = -313.9066

χ^2 (9) = 457.015 (<0.001); Hosmer-Lemeshow χ^2 = 37.576 (<0.001)

Estrella = 0.8159

Table 4. Within sample classification accuracy.

Observed	Predicted		Total	Correct %
	Will not use sexed semen	Will use sexed semen		
Will not use sexed semen	288	24	312	92
Will use sexed semen	5	166	171	97
Overall totals	293	190	483	94

A naïve prediction of all observations not using sexed semen would give a 65% success rate.

The coefficients in Table 3 indicate the effect of the variables on the probability of the farmer using sexed semen. Uptake is significantly and positively influenced by herd size. Producers’ replacement strategy also influences adoption: farmers who intend to increase the proportion of home bred replacements; those who already keep a high proportion of home bred replacements and those with 50% of their stock bred from dairy cows and 50% from suckler cows are more inclined to use sexed semen. Clearly, farmers perceive that sexed semen has value for reducing the proportion of brought-in replacements.

Producers who anticipate problems using AI are less likely to use sexed semen, as are farmers who believe that the bulls from which sexed semen will be taken are not superior to their own choice of bull. Concerns over lower conception rates will decrease take-up rates, as it is well established that conception rate is a key indicator for economic performance for all suckler beef enterprises. Farmers who believe that sexed semen will be too expensive and those who think its use will not increase profitability are less likely to adopt than those who take the alternative view.

These results do not contradict our *a priori* expectations, except that neither LFA status nor breeding season appeared to be major determinants of sexed semen use. Herd size did appear to be a significant factor in uptake, larger herds being more likely to use sexed semen. Exactly how sexed semen might be used is less clear: it is perhaps likely that a small proportion of larger herds would be inseminated with sexed semen so that the technology could be proved before becoming more widely used in the herd.

Besides clarifying the significant determinants of sexed semen use, a formal modelling approach is able to quantify the impact of the significant variables. For example, Equation 1 shows the mean stimulus index for farmer “A” who has 60 cows, does not believe AI bulls are inferior, does not anticipate problems with AI, does not believe sexed semen will be too expensive but who nevertheless does not believe it will be profitable to use, does not anticipate lower conception rates, who intends to increase the proportion of home bred replacements on the next 3 years and has 50% of their current herd comprised of dairy x beef cows and currently retains 20% of heifers for breeding, is computed as:

$$Z_1 = 0.239 + 0.014(60) - 1.632(0) - 7.550(0) - 4.105(0) - 4.391(1) - 5.027(0) + 1.530(1) + 1.081(1) + 1.799(0.2) = -0.3412 \quad (1)$$

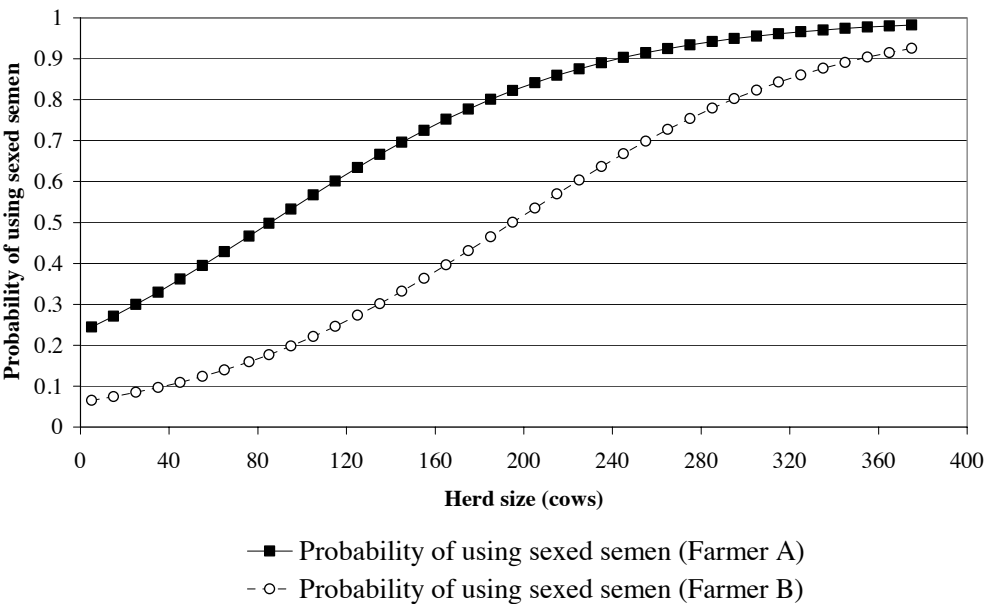
The probability of farmer A using sexed semen is therefore,

$$P_i = e^{-0.34} / (1 + e^{-0.34}) = 0.41$$

or nearly 41%. Figure 1 shows the impact of differences in herd size on the probability of this farmer using sexed semen. In this way the model is able to quantify the change in probability of sexed semen use as herd size increases.

Farmer A can be compared with farmer “B”, who is similar to farmer A in every respect except that he has decided not to increase the proportion of home bred replacements (Figure 1). Again herd size has a positive effect on sexed semen use, but Figure 1 shows the relative importance of replacement strategy over herd size with respect to sexed semen use. At 40 cows, farmer B increases the likelihood of using sexed semen by 20% (from 10% to 30%) if he changes his herd replacement strategy. Without a change in replacement strategy, a similar increase in probability would require an increase in the herd of about 100 cows, which for many suckler cow enterprises would not be feasible.

Figure 1. Impact of herd size and replacement strategy on the probability of using sexed semen.



The model can also be used to predict the changes in the use of sexed semen if the constraints expressed in the model are relaxed. These results for herds and cows are displayed in Tables 5 and 7. For example, Table 5 shows that the number of farmers who would use sexed semen increases from 171 to 195 if farmers thought that the bulls used to supply sexed semen were superior. Tables 6 and 8 display the findings raised to the UK level using raising factors based on the UK’s underlying population of suckler herds and cows drawn from the June 2000 and December 2001 Censuses respectively. The largest constraint to the use of sex semen is problems with using AI. Overcoming this perceived problem is estimated to lead to an increase of 112 herds at the survey level, representing its use by an additional 16,852 herds and 86,810 cows when raised to the UK level (Tables 6 and 8 respectively).

Table 5. Predicted change in the numbers of surveyed herds using sexed semen (SS) with changes in farm management policy and outlook.

Herd size	No of farmers	Predicted original sample	AI bulls are superior	No AI problems	SS affordable	SS use will be profitable	No worries about conception rates	Increase use of home replacements
Cows								
<30	107	39	52	69	55	54	53	52
30<65	136	46	50	76	55	55	52	50
65<100	108	38	41	57	43	45	45	41
>=100	132	48	52	81	54	56	57	52
Total	483	171	195	283	207	210	207	195
% increase			14	65	21	23	21	14

Table 6. Predicted change in the numbers of UK herds using sexed semen (SS) with changes in farm management policy and outlook.

Herd size	No of farmers	Predicted original sample	AI bulls are superior	No AI problems	SS affordable	SS use will be profitable	No worries about conception rates	Increase use of home replacements
Cows								
<30	46 306	17 573	23 223	30 853	25 499	24 356	23 576	23 223
30<65	11 045	3 592	3 850	5 874	4 157	4 299	4 053	3 850
65<100	4 576	1 393	1 422	1 758	1 497	1 611	1 682	1 422
>=100	3 803	1 517	1 564	2 442	1 653	1 719	1 654	1 575
Total	65 730	24 076	30 060	40 928	32 806	31 984	30 966	30 071
% increase			25	70	36	33	29	25

The percentage of cows inseminated with sexed semen would increase less than the percentage of herds using sexed semen following the elimination of

Table 7. Estimates of the numbers of surveyed cows using sexed semen (SS) with changes in farm management policy and outlook.

Herd size Cows	No of cows	Predicted original sample	AI bulls are superior	No AI problems	SS affordable	SS use will be profitable	No worries about conception rates	Increase use of home replace- ments
<30	1 616	541	633	695	583	598	592	580
30<65	6 239	1 283	1 260	1 575	1 363	1 365	1 331	1 318
65<100	8 612	1 171	1 195	1 363	1 214	1 243	1 237	1 195
>=100	23 671	4 034	4 144	5 083	4 143	4 195	4 247	4 130
Total	40 138	7 029*	7 323	8 716	7 302	7 401	7 406	7 222
% increase			3	24	4	5	5	3

* of which, 4,915 to be served with male sexed semen, and 2,114 with female sexed semen

These estimates assume that the farmers who have had the specific constraint removed will serve a similar proportion of their herd with sexed semen as the average for the herd size group of farmers who said they would use sexed semen. These proportions are 0.335, 0.206, 0.136 and 0.17 for the smallest to largest herd size categories respectively.

Table 8. Estimates of the numbers of UK cows using sexed semen (SS) with changes in farm management policy and outlook.

Herd size Cows	No of cows	Predicted original sample	AI bulls are superior	No AI problems	SS affordable	SS use will be profitable	No worries about conception rates	Increase use of home replace- ments
<30	471 714	160 975	171 759	202 641	173 893	173 679	172 595	171 759
30<65	423 934	87 751	89 452	107 176	91 799	93 237	93 237	89 452
65<100	261 073	31 573	31 606	34 131	32 155	33 505	33 669	31 606
>=100	516 278	86 280	87 970	109 621	88 194	89 301	89 447	88 000
Total	1 672 999	366 579*	380 877	453 389	386 041	389 722	386 615	380 816
% increase			4	23	5	6	5	4

* of which, 100 423 to be served with male sexed semen, and 266 156 with female sexed semen

each identified constraint. The reason for this is the response received from the larger enterprises in the survey; a higher proportion of the larger enterprises intend to use sexed semen. Therefore releasing the constraint will have a less than proportionate impact on larger enterprises than on smaller enterprises.

Discussion and Conclusion

One of the main factors that will influence the uptake of sexed semen by suckler beef producers is overcoming the problems involved in using AI. The

survey findings showed that about 58% of farmers said a shortage of labour was the reason for this, whilst 32% stated lack of handling facilities was a problem (Telford *et al.*, 2003). Using artificial insemination on lactating suckler cows will increase labour costs (Doyle, 2000; Seidel, 2003) and given the uncertainties surrounding the payback from the higher expenditure, this will be a more difficult problem to overcome than say one related to training needs.

It has been hypothesised that technologies that generate similar or higher profits by lowering costs are more likely to be used by farmers than those that increase both the value of output and costs. Clearly, there would be substantially less risk involved as reduced costs offer an immediate benefit to the farmer, moreover output-increasing technology increases output which *ceteris paribus* will usually lead to lower market prices (Kalter and Tauer, 1987). Farmers perceived sexed semen as a cost increasing technology.

Herd size has a positive influence on uptake. This may be attributed to the notion that larger farmers tend to be more prosperous and therefore more likely to have funds available to finance any new investment or training that use of sexed semen may necessitate. Being more financially secure may alter their views on the risks involved in using this technology, in particular those related to lower conception rates. Semen dose per straw is lower for sexed than unsexed semen in order to reduce its cost (Johnson, 2000; Seidel, 2003). But if this economy lowers conception rates it will certainly reduce adoption rates.

Attitudes towards replacement policy are clearly important. Long-term trends in the deterioration of suitable dairy-bred replacement suckler cows, coupled to the bio-security concerns raised by Foot and Mouth disease and the subsequently introduced restrictions on cattle movements, have all reduced the attractiveness of running 'flying herds'. The need to source better quality replacements is a positive incentive to use sexed semen. However, suckler beef producers have diverse herd structures and the survey shows that the selection of the bull from which sexed semen is taken is a major concern of farmers.

It is worthwhile to speculate on the availability of sexed semen to change the structure of suckler beef production given the changes to farmer support payments that have recently been introduced. Sexed semen may allow farmers to specialise in producing replacement heifers or male cattle for slaughter and to contract the sale of these to specialist rearers and finishers respectively. This system will produce a more uniform product because of increased genetic uniformity and the possibility of batch raising of calves which will reduce management costs and produce a larger proportion of higher value meat (as animals of lower genetic merit are replaced). Shorter marketing chains and a more consistent product will reduce carcass variability and wastage. The Mid Term Review has substantially decoupled subsidies from production (the degree of decoupling varies with Member States) which strictly speaking means that only those farmers who can farm their enterprise at a profit will retain their herds; the reforms are also likely to increase the average herd size (Revell and Oglethorpe, 2003). As the survey was conducted before the details of the Mid Term Review were known, its impact on sexed semen use could

not be included in the farmers' responses, but the model suggests larger herd sizes would increase the use of sexed semen.

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Bibliographical Notes

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Appendix A

The logit adoption behavioural model follows the form:

$$Y_i = G(Z_i) \quad (A1)$$

$$Z_i = b_0 + \sum_{j=1}^k b_j X_{ji} \quad (A2)$$

where Y_i is the observed intention to use sexed semen (i.e. a binary variable with $Y_i=1$ for adopters and $= 0$ for non-adopters); Z_i is the underlying and unobserved stimulus index for the i th observation (conceptually there is a critical threshold (Z_i^*) for each farmer, if $Z_i < Z_i^*$ the farmers is predicted to be a non-adopter); G is the functional form chosen to relate the farmer's intentions towards using sexed semen and the stimulus index that determines the probability of using sexed semen; $i = 1, 2, 3, \dots, n$, are the number of observations in the sample; X_{ji} is the j th explanatory variable for the i th observation, $j = 1, 2, 3, \dots, k$; b_j is an unknown parameter that is estimated in the model, $j = 1, 2, \dots, k$; b_0 is a constant; k is the number of explanatory variables.

The logit model assumes that the underlying stimulus index (Z_i) is a random variable which predicts the probability of using sexed semen.

$$\text{Probability (event) } P_i = e^{Z_i} / (1 + e^{Z_i}) = 1 / (1 + e^{-Z_i}) \quad (A3)$$

Therefore, for the i^{th} observation, the stimulus index is a linear combination:

$$Z_i = \ln [P_i / (1 - P_i)] = b_0 + b_1 X_{1i} + b_2 X_{2i} \dots \dots b_j X_{ji} \quad (A4)$$

The probability of the event not occurring is estimated as:

$$\text{Probability (no event)} = 1 - \text{Probability (event)} \quad (A5)$$

THE MIDDLETON MEMORIAL LECTURE

FARMERS, TRAINING AND BUSINESS PERFORMANCE: DOES IT STACK UP?¹

S. M. Byles

The paper presents the findings of a telephone survey of farmers' involvement in continuing professional development (CPD), and the impact of this involvement on the farmers and their businesses. The problems of measuring the amount of CPD farmers undertake and of identifying its impacts are discussed. The findings suggest that CPD did not necessarily deliver a positive impact on profit - but farmers identified other directly related (non-pecuniary) benefits of CPD. The conclusions suggest that farmers, funders and deliverers can improve the impact of CPD by linking the objectives of the training schemes to the motivations which underpin farmers' decisions to participate in CPD.

Keywords: Continuing professional development, farmers, business performance.

Introduction

Government recognises its role in the need to improve the skill base for rural industries (Defra 2002). It has *inter alia* supported and promoted schemes for vocational training aimed at the farming and rural sector. In response to these incentives, deliverers have developed programmes that build skill levels and capacity within the industry. Significant progress has been made and the range and number of vocational, developmental and technological interaction programmes available to farmers has increased, yet there remains little published research on the impacts of these schemes on farm or farmer performance.

A number of studies have evaluated the impact of training programmes on farm performance. Given the importance of financial management for successful farming operations, Jackson-Smith *et al.* (2003) measured the contributions of training on the financial performance of dairy farmers in Wisconsin. They found only a weak link between financial understanding and improved returns: exposure to relevant programmes and improved self-confidence in financial decision-making were not related to successful financial outcomes. Cameron (2000) investigated informal training and concluded that extension programmes had a positive impact on practicing farm managers, through changes in knowledge, attitudes, skills and aspirations that led to recorded changes in management practice, with more changes expected. Cameron (2000) used a number of self-reported criteria to measure impacts but Jackson-Smith *et al.* (2003) challenged outcomes that rely upon self-reporting; that is farmers measuring their own performance as opposed to it being independently validated.

Kilparick (1997) studied the impact of training programmes on farm profitability in Tasmania. She found it difficult to make conclusive statements about the impact of the training courses on a farm's economic or sustainability outcomes because of the difficulty finding a control group that exactly matched the profile of the training programme participants. Clearly, many variables other than the training programme might affect profitability and

1. This paper was presented on the 17th November 2004 at the National Farm Management Conference, Bedford, UK.

sustainability, but she did find evidence that participants who made changes in their behaviour or farm practices following a training programme did have more profitable farms.

An alternative approach is to assess strategies for targeting knowledge (technology transfer programmes) (Garforth *et al.* 2003). For example, the use of information acquired through specific technology transfer programmes could be considered a form of continuing professional development (CPD).

Beyond agriculture, in the world of business and management, there are examples of methods that are used to assess the impacts of professional development schemes and to measure the return on investment in training and development (Phillips 1997). In this literature, the issue of self-reported outcomes remains, and consideration is given to other more precise measures for the impact of training and development activity. For example, selecting measures that align with personal or business objectives, using peer review and professionally identified targets. Phillips (1997) attributed improvements in the return on investment in training and development as representing a paradigm shift as individuals switch from participating in training simply to participate in the activity itself to wishing to use the information conveyed in the training to improve performance. This observation, although explored in the corporate business world, has not been studied in relation to training outcomes for programmes targeted at UK farmers.

The term CPD is defined within the Institute of Agricultural Management, but not all farmers recognise the term, or that it applies to activities they currently undertake. Hence, programmes that describe themselves as “training” or “developmental activity” may form a component of CPD. Recording vocational training/CPD activities is being encouraged as a method of demonstrating proficiency, for example, the Institute of Agricultural Management and National Register of Spray Operators (NRoSO) are organisations that encourage recording activities. However, CPD is currently not mandatory across the industry.

Some funding mechanisms and assessments of vocational training and CPD appear to be driven and judged by the numbers of participants attending the activity. Indeed, some bid applications for vocational training scheme (VTS) activity measure a “costs per beneficiary day” metric. Such metrics appears to measure benefits of vocational training / development activity purely in terms of attendance.

It is clear therefore, that a number of questions arise as to the role and impact of training and development activities, and to its measurement. This paper appraises CPD as a general rather than a specific activity. The next section identifies farmers’ current developmental activity and its relationship to performance and other personal and farm characteristics. This is followed by the presentation of results of a survey into vocational training schemes, which compares self-reported metrics with more considered, structured review of the CPD the farmers actually undertook in 2003. This is followed by a discussion of the findings of the survey and a short conclusion looking at the need to focus measures of the success of CPD on farmers’ motives for undertaking CPD.

Materials and methods

Key research questions were identified using a semi-structured interview to record farmers' perceptions of success, business performance and training. The results of this preliminary study allowed the formulation of the following research questions.

- What types of development activity do farmers attend?
- What are the stimuli (triggers) that motivate farmers to participate in development activity?
- Does participation result in changes in working practices and/or benefit?
- Does participation have any impact on participant's business performance?

The outcomes led to an additional important question that may be critical in achieving benefits from continuing personal and professional development:

- Are farmers undertaking development simply for the activity itself or to obtain discrete (and measurable) benefits from that activity?

A survey of farmers in southwest England was conducted to answer these research questions. Participants were selected from a sample of farmers participating in the Duchy College Agriculture Department's Vocational Training Scheme (DCVTS). A random sample of 650 VTS participants was generated from a large database, from which 214 farmers were surveyed by telephone based on the following selection criteria:

- all the participants had to have undertaken at least one form of vocational training development between July 2000 to December 2003;
- all were 18 years old or over; and
- all had some managerial responsibility.

All participants were asked to supply information on:

- their current financial performance (current profit / loss and the annual change in profit / loss);
- their self-perceptions of the impact of the changes to their business resulting from the training (to identify respondent's behaviour in relation to the business);
- information regarding CPD was also obtained (namely the numbers of days/hours and the types of activity undertaken);
- training needs and the training they currently intended to undertake;
- the stimuli for enrolling in development activity;
- current training needs; and
- the farmer's perceived actions and benefits resulting from their participation in CPD.

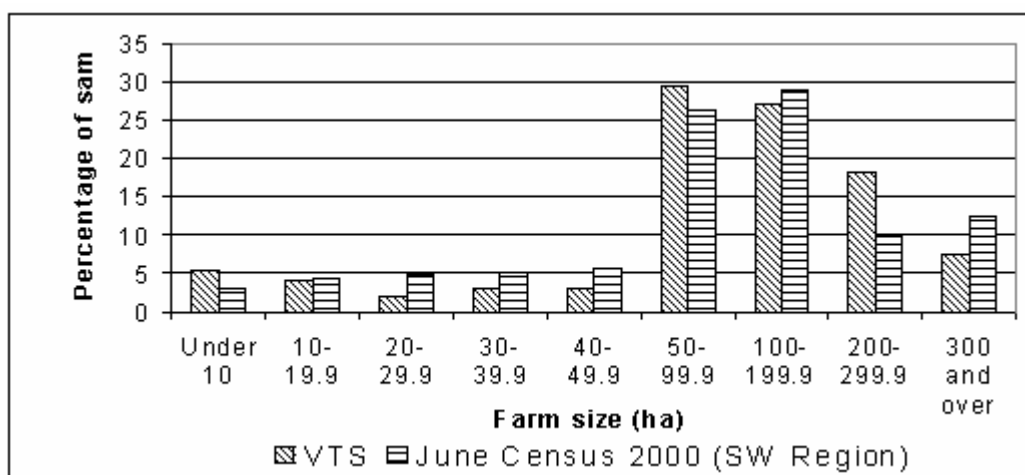
To evaluate how CPD fitted in to their overall business, respondents were asked to give their reasons for continuing in farming and what metrics they

currently used to measure business performance and success.

Results

A total of 214 useable responses were obtained. Eighty-one percent of respondents were owner-managers or managing partners in their business, the remaining 19% were family members, farm managers or staff involved in day-to-day decision making. Total farm area managed by the respondents was 31,919 ha; with farm size varying from under 1 ha to 2,023 ha, with an average of 150 ha. This profile is similar to the June Census data of 2000 (Figure 1). The survey respondents were classified as far as possible using Defra's FBS classification system (Turner, M. *per. comm.*) and found to be representative of farm types in the survey area.

Figure 1. Distribution of farm size for DCVTS sample and June Census 2000.



What types of development activity do the respondents attend?

Table 1 shows that the most common activity was attending discussion groups, 133 of the 214 respondents (62%). This was 10% higher than the next highest category, attendance at field- or demonstration-days (52%). Discussion groups were also ranked highest in terms of days attended; 39% of the total days spent in CPD were spent in discussion groups. The next most time consuming CPD was field/demonstration-days (Table 1). A total of 56% of the time spent in CPD was engagement with discussion groups or at field/demonstration-days (Table 1).

Not all farmers attended every type of activity. Table 2 shows the mean, median and mode for attendance for the full sample. Taking all types of CPD into account, the highest number of CPD days by a single person in one year was 105, and the mean CPD per respondent was 10 days. Table 2 also shows that 56 respondents did not consider they attended any CPD in 2003. However, farmers were then led into a discussion of various types of CPD activity drawn from a pre-prepared list, and asked again how many CPD days

they had undertaken. The second totals differed markedly from the first. The number of farmers who reported undertaking no CPD fell from 56 to 4, and the mean days spent in CPD increased from 4 to 10.

Table 1. Type of CPD activity attended (214 farmers on 1578 participating days)

Type of CPD	% of respondents attending at least one day	Days attended (% of all days)
Discussion group	62	39
Field/Demonstration day	52	17
Workshop or seminar	37	10
Study tour	14	6
Training programme with qualification	11	11
Training programme without qualification	16	5
Computer training	20	12

Table 2. Number of all days of CPD by category (2003).

	Number of CPD days		
	All days (after prompting)	Excluding shows & self-learning 2003	Yearly average (unreflective)
Descriptive statistics			
Mean	10 (0.73)*	7 (0.68)	4 (0.41)
Median	7	5	2
Mode	4	0	0
Minimum	0	0	0
Maximum	105	100	50
Number people with zero days CPD	4	34	56

*Standard errors in parenthesis

N=214

Fifty eight (27%) of respondents deliberately set time aside to reflect on their training and development needs. This sub-group of farmers attended an average of 15 days of CPD in 2003, compared to an average of 8 days for the sub-group of farmers who did not spend time reflecting on their personal CPD requirements.

What are the stimuli (triggers) for farmers to undertake development activity?

Reading and publicity material was the direct stimulus for 42% of the 58 farmers who set time aside to identify their training or development requirements. Three per cent of the full sample maintained a written training and development plan; 43% said that business or legislative requirement directed their activity; 29% cited personal interests and requirements; 13% did not know or could not identify any particular stimuli; and the remaining 11% included some respondents who had been instructed to attend training courses.

Do farmers take action or benefit from the training activity?

Farmers were asked to identify changes that had occurred in their businesses between 2001 and 2003; Table 3 summarises their responses. Of the farmers who did identified changes, 29% directly linked the training and development activity to at least one of those changes.

Table 3. Frequency of changes to businesses (between 2001-2003).

Change category	Number making changes	Percentage
Land farmed	77	36
Enterprise mix or husbandry	91	43
Staff management	60	28
Finances & investment	107	50
Markets	39	18
Management	66	31
Significant other	10	5
N=214		

Farmers were asked to reflect on their training and development activity undertaken in 2003 to identify any action, planned action or benefit directly related to CPD. Eighty-four per cent identified some action, planned action or benefit from their CPD. Where farmers had not taken action but where benefit was reported, the benefit was associated with increased confidence, awareness and interaction with others, and with improved methods of management. It could be argued that these are identifiable actions; however the actions were self-reported and not considered as such by those particular respondents.

Nine people stated that they had not done any training or development in that 12-month period. This differs from the results for the categorised CPD (see Table 2), thus again highlighting the concerns regarding inconsistency when asking farmers for their perceptions or recollections of activity.

Twenty-six farmers (12%) stated that their CPD activity had had no benefit. The reasons these farmers gave to explain this included: external factors that prevented implementation (3 responses), the training was a

refresher course only (1 response), no chance to use the taught information since the course (2 responses), no need to change as things already going smoothly (5 responses). Other responses included, that the training had no direct benefit to my business, the training was too basic, I already knew the knowledge, I did not receive sufficient information/knowledge to make change, the training was not practical enough, and I did not continue with the training.

Does the development activity have any impact on their capacity or their business performance?

This open question raised the issue of how farmers measured their business performance. Responses are summarised in Table 4.

Table 4. Performance measures used by the farmers.

Category	Frequency (%) of performance measure identified
Financial	231 (85)
Physical	15 (5)
Other	7 (3)
None or Don't know	19 (7)
N=214	

Further analysis of those farmers who measured business performance showed most use financially related metrics. However, 15% used non-financial criteria (even though financial related metrics were widely drawn to include bank statements and tax accounts). Five per cent used physical performance indicators.

On the basis of these findings, the research assessed the effect of CPD delivered to farmers on the change in financial performance (Table 5). This was done by comparing the farmers who stated they had had an increase in profit in the previous financial period with those who had identified direct action or benefit as a result of training or development activity. 117 of the 214 farmers (83%) provided financial information, but even so, the research was not able to identify any definite positive impact of the training and development on profitability..

Table 5. Farm businesses on which CPD inputs either changed profitability or on which no changes to profits were recorded

	Profitability of business(%)	
	Improved	No change or deterioration
Overall	49	50
Non-specific changes made to business	46	54
Specific actions or benefit made following CPD	50	49
N=177		

Finally all the participants were asked to prioritise three objectives and goals for themselves and their farm business. Responses were categorised and correlated to the farm's performance measures and to the farmers' motivation for undertaking CPD. The results indicated a commonality between "goals and performance measures" of 0.09 (9%), between "goals and stimuli for undertaking CPD" of 3%, and between "performance measures used and stimuli for undertaking CPD of 6%.

Discussion

The findings of this paper have quantified issues that previously were largely anecdotal. For example, after discussions about CPD, farmers actually found that they completed, on average, 6 days more CPD than they perceived they would in an average year. This difference is likely to have three main reasons. Firstly, because the CPD farmers recalled undertaking in 2003 was more than they would normally undertake in an average year. Secondly, farmers' perceptions of their involvement in CPD changed when they were asked to think more clearly about what they had actually done in that year (but still using their own perception of what constitutes CPD). Thirdly, farmers do not perceive categories of activities the research defined as being CPD as being a training or development activity. Previous papers, such as Jackson-Smith (2003), reported on the CPD activities delivered to the trainee, not the trainee's perception of what was CPD, clearly demonstrating the importance and uniqueness of these research findings.

The average farmer could be confident of spending between 60 and 70 hours on CPD activity a year. This compares favourably to other industry CPD schemes already in place. The Royal Institution for Chartered Surveyors (RICS) requires 60 hours spread over a three-year period, The Institute of Agricultural Management suggests a minimum of 30 hours spread over every consecutive three year period with, ideally, at least 10 hours per annum.

Not all farmers participated in each type of CPD activity. This may be because not all of these activities were available and/or accessible to all farmers. It may also indicate that farmers have different learning preferences, suggesting that no one form of CPD activity suits every farmer, indicating that a range of activities must be made available. Farmers have demonstrated this by the specific types of activity attended. The highest number of days attendance by one person in one category in the year was 50 days on training with qualification outcome.

There are other factors that need to be considered before any conclusion can be drawn. The key point being how these responses relate to the development activity available? This information was not known, as farmers were able to attend a range of developmental activity outside those provided by DCVTS.

The use of 'training needs identification methods' by the surveyed farmers is minimal. Active identification of training and development needs was recognised by just over a quarter of respondents. These farmers attended an average 15 days CPD, compared to 8 days for those who did not consider their CPD requirements. Self-reflection clearly led to more CPD activity.

The largest single reason for undertaking CPD activity was "for business

or personal requirement". Yet when probed for current training and development requirements nearly half stated they had 'no requirement' or 'did not know of any'. Given the rapid changes within the industry, this is a surprisingly high figure and suggests the farmers tend to be reactive rather than proactive in undertaking training. A large number of those who did identify training needs identified them from reading or through publicity materials. This would appear to confirm the reactive nature of identifying training requirements. The responses raise concerns about the appropriateness and understanding of methods for identifying developmental needs as a management tool.

Farmers predominately measured business performance using some form of financial indicator. However, profitability was not shown to be linked to any CPD metrics explored on this survey. This concurs with previous research by Jackson-Smith *et al.* (2003) and Kilpatrick (1997). Several issues arise from this. Firstly, is change in profitability an appropriate financial measure for business performance? Secondly, might it be better for the measure of CPD performance to be aligned with each farmer's reasons for continuing in farming. Thirdly, should farmers select their CPD activity depending on their own business aims and objectives, selecting those that deliver outcomes aimed at improving these metrics rather than those with other aims and objectives?

The performance measures used in the respondents farming businesses are not always directly associated to business or personal goals (although the financial measures may be implicit to the goals of other more desired end (Gasson 1973)). The results presented in Tables 5 and the lack of commonality of stimuli or performance measures with goals point to concerns over the assessment of the impact of CPD on farmers and businesses by using inappropriate measures. It suggests that without specific information on the goals of the business, the relevant performance measures that should be used to assess the value of CPD cannot be identified: assessment of value using generic measures, or by self-reporting, would appear to be invalid - at best they are merely anecdotal.

Many farmers are training for activity rather than results or demonstrable outcomes. The data suggests that farmers undertake training and development without any specific objectives arising from this activity (Phillips 1997). Farmers believe that training and development activity has enabled them to take or plan action, and benefited them/their business, yet this is not demonstrated by improvement in performance measures.

It is worthwhile reflecting on the methodological challenges of using a telephone survey and of possible discrepancies in the differences between self-reporting and independent information. This analysis has reinforced Jackson-Smith *et al.* (2003) concern with self-reported information, whilst their research was related to self-reporting of financial information this research has found a similar problem exists with the self-reporting of CPD activity.

Conclusions

The results in the survey give no doubt that the majority of the farmers have implemented or have benefited from their recent training and development activity. This in itself should commend CPD activity and

encourage the range of different types of activity. But to encourage more of the farming community to engage in training and development a clear demonstration of impact of the activity on business performance would be advantageous - these results do not demonstrate that action or benefit translates into a positive impact on profits. Farmers, funders and deliverers can improve the impact of CPD by clearly identifying the role each party needs to play, by explaining how the expected outcomes of the CPD will be achieved, and by matching these measures of outcome to the reasons that motivated the farmers to attend the CPD in the first place.

Acknowledgement

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INVITED ARTICLE

HARNESSING THE SOCIAL AND NATURAL SCIENCES FOR SUSTAINABLE RURAL DEVELOPMENT: INTRODUCING THE RURAL ECONOMY AND LAND USE PROGRAMME

Jeremy Phillipson, Jo Daymond, Philip Lowe and Richard Lee

The article introduces the research commissioned under the first round of funding of the Rural Economy and Land Use Programme. The programme is a major UK Research Councils' initiative involving interdisciplinary research into many of the pressing public challenges facing the countryside. The bulk of funding under the first round of research proposals examines the theme of sustainable food chains, with smaller scoping and capacity building studies exploring the integration of land and water use, the environmental basis of rural development and economic and social interactions with the rural environment.

Background and objectives

Rural areas are facing major social, economic, environmental and technological change. Key public challenges for research include:

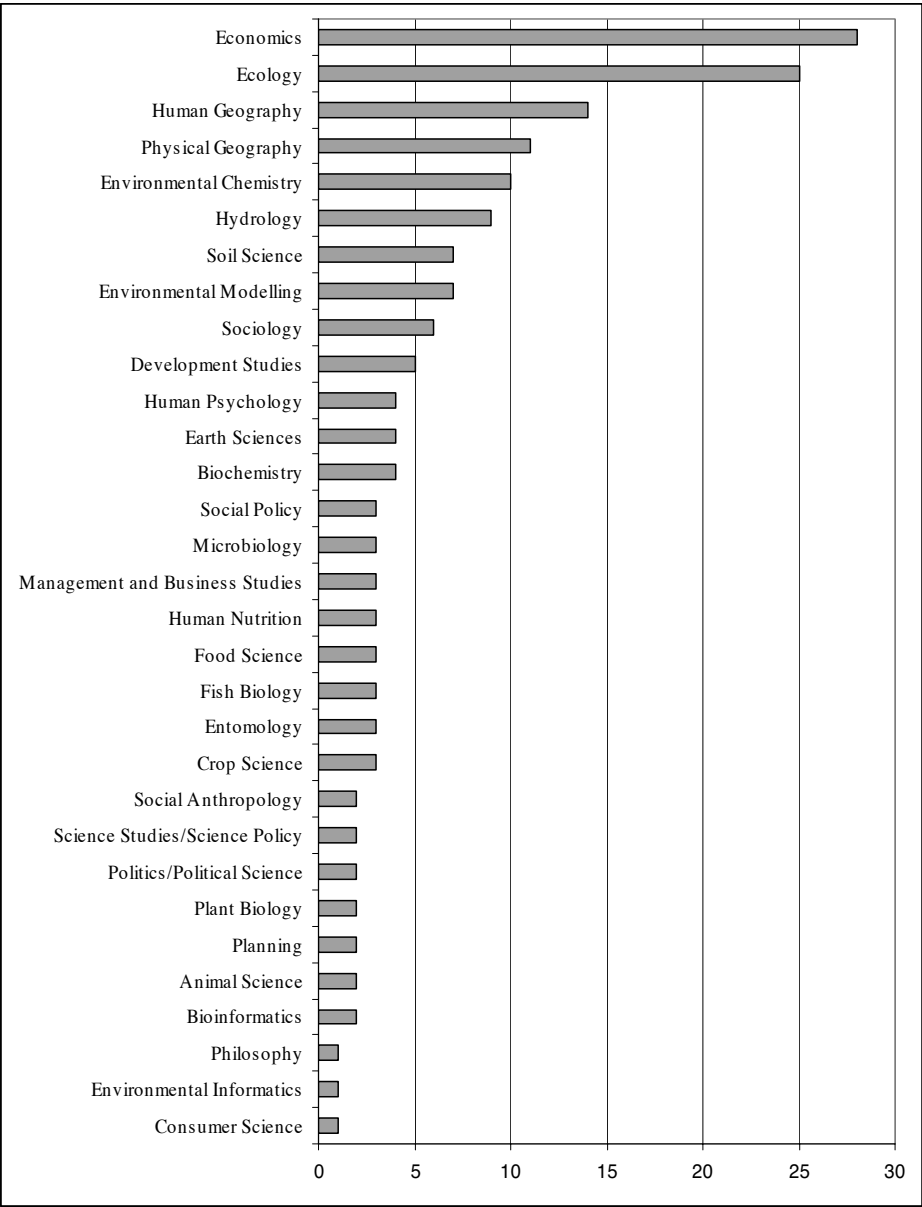
- how to restore trust in food chains? - research has shown that the food safety issues causing greatest concerns to consumers are the use of pesticides, antibiotics and hormones in food production (Brennan *et al.*, 2004)
- how to tackle animal diseases in a socially acceptable manner? - in the 2001 Foot and Mouth outbreak over 6.5 million livestock were culled (Defra, 2003) and £3 billion was lost to tourism (Report by the Comptroller and Auditor General, 2002)
- how to sustain agriculture in a liberalised economy? - CAP reforms have decoupled subsidies from production, with unknown consequences for the maintenance of the countryside
- how to promote robust rural economies? - 1.4 million low income households are found in rural areas, with earnings at their lowest in the more peripheral parts of the country (Countryside Agency, 2004)
- how to alter land management to take pressure off the countryside, to anticipate climate change and challenges from invasive pests and pathogens – one in eight of the 20,000 native UK species are threatened
- how to manage land use and water use to take stress off water catchments? - diffuse pollution from farmland accounts for 50-70% of

1. The programme is an unprecedented collaboration between three Research Councils, the Economic and Social Research Council (ESRC), the Biotechnology and Biological Sciences Research Council (BBSRC) and the Natural Environment Research Council (NERC). It has a budget of £20 million, with additional funding from the Scottish Executive Environment and Rural Affairs Department and the Department for Environment, Food and Rural Affairs. Further details about the programme and on all the research can be found at <http://www.relu.ac.uk/>.

the nutrients contaminating rivers and lakes (Defra, 2004).

The Rural Economy and Land Use Programme (RELU) aims to advance a holistic understanding of these challenges in order to inform policy and enable better practice for the countryside. An underlying premise of the programme is that the challenges facing rural areas cut across disciplinary boundaries and therefore require an interdisciplinary research response. This interdisciplinary response aims to: avoid partial framings of research questions; gain integrated perspectives on problems; and place technological developments and environmental constraints in their social and economic contexts.

Figure 1: Number of investigators by discipline



RELU is one of the most ambitious interdisciplinary programmes ever conducted by the UK Research Councils², with its commitment to do interdisciplinary work across the social and natural sciences in all projects funded.

The programme is achieving a significant mobilisation of the UK research community. In its first round of funding it has allocated £6.2 million to 35 projects, involving over 200 researchers from 45 institutions. The bulk of the funding has been invested in 8 Major Research Projects (of up to £1 million) around the theme of *Sustainable Food Chains*. Twenty seven smaller awards (of up to £50,000) under the heading of *People and the Rural Environment* have been made to assist in the building of interdisciplinary connections and the scoping of three other research themes on: the integration of land and water use; the environmental basis of rural development; and economic and social interactions with the rural environment. These themes will be the subject of major awards in later rounds of programme funding.

So far over 30 disciplines are involved in RELU projects (figure 1). This is an unprecedented spread of expertise. The most prominent disciplines to date include economics, ecology, human geography, physical geography, environmental chemistry and hydrology. RELU is also forging less well established disciplinary collaborations, for example projects that embrace philosophy and soil science, and crop science and development studies.

Sustainable Food Chains

Eight interdisciplinary research projects have been awarded the bulk of first round funding under the theme of Sustainable Food Chains (see Annexe 1). Research into the long term sustainability of food production is being conducted in light of the growing awareness of the environmental and social costs associated with where our food comes from and how it is produced. The projects cover issues of public trust in agriculture technologies, risk management and the redirection of food chains towards changing consumer demands for more nutritious and wholesome foods.

From field to farm to fork, risk is an inherent feature of the food chain. Risk issues range from contamination of water sources by farm run-off to consumers' concerns over food safety.

The RELU project "*Sustainable and Holistic Food Chains for Recycling Livestock Waste to Land*" is examining the changes in farm management needed to control pathogen transfers from grazing livestock and animal effluents (including slurry, dirty water, solid manure). The project is determining the impacts at farm level of changes in management to reduce risk, as well as 'knock-on' effects on the local economy.

Notions of food chain risk are central to the project "*Integration of Social and Natural Sciences to Develop Improved Tools for Assessing and Managing Food Chain Risks Affecting the Rural Economy*". This project brings together natural science modelling of risks and uncertainties in the food chain with social science approaches to understanding consumer behaviours, risk communication and participatory processes. The research involves the design,

2. At programme level RELU is built on strategic co-operation between the three Research Councils, involving pooled funding and staffing resources and the development of combined communication, data and assessment policies.

development and evaluation of participatory tools for involving stakeholders throughout the management and mitigation of risk events, ensuring that full account is taken of potential social, economic and political impacts and public health related safety issues.

Concern with diet and health is moving the subject of nutrition much higher up the agenda. At the same time there is growing public attention to the provenance and environmental sustainability of food production. Such shifts in attitude have major implications for rural economy and land use.

One RELU project, involving research in the UK, Greece and Kenya, is providing a *“Comparative Assessment of Environmental, Community and Nutritional Impacts of Consuming Fruit and Vegetables Produced Locally and Overseas”*. A range of factors are being considered, including: the nutritional quality of fresh compared to stored produce; consumer perceptions of the relative importance of product attributes such as health benefits and place of origin; the total contribution of greenhouse gases from production and transport of vegetables; and the importance of local food cultures.

Nutrition and health provide the main focus of the project *“Implications of a Nutrition Driven Food Policy for Land Use and the Rural Environment”* which is examining the potential for British agriculture to deliver healthy foods that consumers would buy, and assessing the impact on land use, employment and the rural environment. The research is considering the effects of novel fruit and vegetable production systems on nutrient levels of health-related phytochemicals, as well as the impact of extensive livestock production systems on the fat composition of ruminant meat and dairy products. Researchers are exploring consumer attitudes and behaviours and their willingness to pay for healthier and locally produced foods.

The project *“Eating Biodiversity: An Investigation of the Links between Quality Food Production and Biodiversity Protection”* examines the promotion of wildlife conservation as an essential part of the food chain. The research is considering the opportunities for a ‘win-win’ situation where higher food quality and value can be directly linked to maintaining and improving biodiversity within agricultural production systems.

“Warm Water Fish Production as a Niche Production and Market Diversification Strategy for Organic Arable Farmers” considers the potential of tilapia production – a warm water fish – as a farm diversification strategy. Current knowledge/perceptions of industry and consumers are being examined regarding health benefits, food safety, costs and risks, together with implications on farm enterprise decision-making. The research is also exploring the potential for novel forms of ‘closed-system’ fish production units that promise to be more efficient, eliminate environmental impacts and enhance animal welfare.

Consumers, retailers and environmental interest groups would like to see less use of chemical pesticides in food production. More sustainable, biologically-based solutions are potentially available. However, uptake of such methods is not extensive. Two RELU projects are addressing the opportunities and obstacles from complementary viewpoints:

The project *“Re-Bugging the System: Promoting Adoption of Alternative Pest Management Strategies in Field Crop Systems”* is looking primarily at

two alternatives to chemical sprays: the use of beetle banks to increase numbers of predatory insects for crop pathogens; and the use of semio-chemicals, to lure pests out of the crops or to attract predatory insects towards them. These methods are being examined for the scope they offer for practical tools of pest management. Potential obstacles to their use – such as farmer indifference or consumer resistance – are also being investigated.

While the first project is working at overcoming market barriers, the second project “*Biological Alternatives to Chemical Pesticide Inputs in the Food Chain: An Assessment of Environmental and Regulatory Sustainability*” is looking at possible regulatory obstacles. It is examining the regulatory system for pesticides in the UK and in other European countries to assess whether changes in regulations, which are currently oriented to the use of chemical pesticides, might encourage a shift towards bio-pesticide use.

People and the Rural Environment

Under the first round of funding 27 smaller projects are focussing on scoping research and capacity building around RELU’s three other major research themes (see Annexe 2).

The integration of land and water use

Rural land use shows insufficient attention to the effects on water resources, leading to unacceptable pressures. Projects are exploring the obstacles to, and means of, achieving integrated land and water use:

- Exploring the interactions between social, economic and environmental factors impacting on catchments
- Reviewing integrated catchment management approaches and tools
- Considering the role of stakeholder engagement and the different kinds of knowledge (social, ecological, economic, cultural) that may be brought to bear in catchment management
- Exploring cross-disciplinary understandings of the causes and consequences of diffuse agricultural pollution
- Modelling interactions between climatic change, farmer responses and water quality
- Learning from international experiences of integrated management of land and water resources

The environmental basis of rural development

Rural landscapes, environments and lifestyles make important contributions to the quality of life and the competitiveness of regions. RELU researchers are exploring the means of achieving a sound environmental foundation for rural conservation and regeneration:

- Developing integrated information systems for assessing agricultural sustainability
-

- Modelling interactions between biophysical and socio-economic processes
- Identifying sustainable approaches and priorities for soil management
- Exploring obstacles within socio-political systems and the biophysical landscape that may inhibit sustainable farming practices
- Investigating the role and conditions of farmer collaboration in delivering environmental and landscape wide benefits
- Exploring the processes of innovation and learning by farming enterprises
- Considering the implications of CAP reform for incentive structures, land use and ecology
- Modelling the relationships between biodiversity and agricultural production at different scales

Economic and social interactions with the rural environment

Projects are exploring the changing social and economic functions of countryside, considering what shapes them, assessing their environmental consequences and identifying means of managing them sustainably:

- Developing multidisciplinary methodological frameworks to monitor and evaluate the management of the uplands
- Investigating the interaction of social, economic and environmental conditions in governing land use change
- Reviewing the role of landscapes as a framework for understanding and promoting sustainable development
- Exploring understandings of and methods for analysing landscape quality and the impacts of landscape change

Conclusion

Casting research in a broad social and economic framework, the RELU programme is beginning to demonstrate a strategic potential to prioritise biological and environmental processes that underpin larger scale processes of sustainable development. In doing so, it is building new interdisciplinary capacity. On the one hand, between the bio-science and social science communities the research is strengthening and/or forging links that were previously weak or non-existent. This is enabling cooperation on cross-cutting issues of critical importance concerning plant/animal and human interactions. On the other hand, the programme is drawing together the environmental and social science communities. Projects are exploring methods for combining data and analysis at different spatial scales. This is paving the way for integrated data management systems, as well as developing powerful tools for research and decision making on human-environment interactions.

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Dr Jo Daymond is an environmental scientist and experienced writer and communicator. She is Communications Manager for RELU.

Professor Philip Lowe OBE, Director of the RELU programme, is a leading figure in the development of interdisciplinary rural studies in the UK. Philip holds the Duke of Northumberland Chair of Rural Economy at the University of Newcastle upon Tyne. He is a Board member of the Countryside Agency, and a member of the Science Advisory Council of the Department for Environment, Food and Rural Affairs. He was appointed OBE in 2003 for his contribution to the rural economy.

Richard Lee is Research Associate at the Centre for Rural Economy, University of Newcastle.

Annexe 1. Sustainable Food Chain Projects

Eating Biodiversity: An Investigation of the Links between Quality Food Production and Biodiversity Protection	Professor Henry Buller, Centre for Rural Research, University of Exeter	h.buller@exeter.ac.uk
Comparative Assessment of Environmental, Community & Nutritional Impacts of Consuming Fruit and Vegetables Produced Locally and Overseas	Professor Gareth Edwards-Jones, School of Agricultural and Forest Sciences, University of Wales, Bangor	g.ejones@bangor.ac.uk
Biological Alternatives to Chemical Pesticide Inputs in the Food Chain: An Assessment of Environmental and Regulatory Sustainability	Professor Wyn Grant, Politics and International Studies, University of Warwick	w.p.grant@warwick.ac.uk
Warmwater Fish Production as a Niche Production and Market Diversification Strategy for Organic Arable Farmers with Implications for Sustainability and Public Health	Dr David Little, Institute of Aquaculture, Stirling University	d.c.little@stir.ac.uk
Implications of a Nutrition Driven Food Policy for Land Use and the Rural Environment	Professor Bruce Traill, School of Agriculture, Policy and Development, University of Reading	w.b.traill@reading.ac.uk
Sustainable and Holistic Food Chains for Recycling Livestock Waste to Land	Dr David Chadwick, Soils Environmental and Ecological Sciences, IGER	david.chadwick@bbsrc.ac.uk
Integration of Social and Natural Sciences to Develop Improved Tools for Assessing and Managing Food Chain Risks Affecting the Rural Economy	Professor Richard Shepherd, Department of Psychology, University of Surrey	r.shepherd@surrey.ac.uk
Re-Bugging the System: Promoting Adoption of Alternative Pest Management Strategies in Field Crop Systems	Dr Alastair Bailey, Department of Agricultural Science, Imperial College, London	alastair.bailey@imperial.ac.uk

Annexe 2: People and the Rural Environment Projects

A Cross-Disciplinary Methodology to Promote an Holistic Understanding of Diffuse Pollution Issues in Rural Environments	Professor Louise Heathwaite, Lancaster Environment Centre, University of Lancaster	louise.heathwaite@lancaster.ac.uk
Building Networks for a RELU Capacity Building Programme: Exploiting Options from the Eastern US and Nearby European Continent	Dr Hadrian Cook, Agriculture Sciences, Imperial College London	h.cook@imperial.ac.uk
Developing an Interdisciplinary Approach to Address Environmental and Social Issues Resulting from Changes in Land Use in the English Lake District	Professor Edward Tipping, Department of Environmental Chemistry and Pollution, CEH Lancaster	et@ceh.ac.uk
Analysing Visual Quality in Relation to Landscape Change Scenarios: An Assessment of the Requirements	Professor David Miller, Landscape Change, Macaulay Institute	d.miller@macaulay.ac.uk
Building Capacity to Investigate the Potential Role of Sustainable Agricultural Intensification in AgroEcological Systems	Dr Noel Russell, School of Economic Studies, University of Manchester	n.russell@man.ac.uk
Climate Change, Non-Point Pollution and Land Use: Modelling Interactions	Professor Nick Hanley, Economics Department, University of Stirling	n.d.hanley@stir.ac.uk
Co-operative Management of the Agricultural Environment (Co-ManAge)	Dr Jeremy Franks, School of Agriculture, Food and Rural Development, University of Newcastle	J.R.Franks@ncl.ac.uk
Designing and Implementing Large Scale Experiments in Land Use	Dr Matt Thomas, Agricultural Sciences, Imperial College London	m.thomas@imperial.ac.uk
Private Sector Environment Standards: Impact on Ecological Performance and International Competitiveness of UK Agriculture	Dr Richard Baines, School of Rural Economy and Land Management, Royal Agricultural College	richard.baines@rac.ac.uk
Data Resources for Rural Sustainability Research: Realising Their Combined Potential	Dr Nigel Boatman, Central Science Laboratory, Wildlife Ecology and Management Group	n.boatman@csl.gov.uk
Understanding Loweswater: A Study to Generate New Understandings of Ecological, Economic and Social Interactions in a Lake District Catchment	Dr Stephen Maberly, Ecosystem Assessment and Forecasting Section, CEH Lancaster	scm@ceh.ac.uk
Developing Tools for Interdisciplinary Research: Physical and Social Science Perspectives on the Use of Rural Catchments	Dr Elizabeth Oughton, Centre for Rural Economy, University of Newcastle	e.a.oughton@ncl.ac.uk

Developing Spatial Data for the Classification of Rural Areas According to Socio-Economic and Environmental Sustainability Factors	Dr Meg Huby, Department of Social Policy and Social Work, University of York	meh1@york.ac.uk
Development of a Landscape Intervention Decision Support System (LIDSS) to Maximise Net Social Benefit	Professor David Macdonald, Wildlife Conservation Research Unit, University of Oxford	david.macdonald@zoo.ox.ac.uk
Gentrifying Rural Natures: An Investigation of the Enrolment and Modification of Nature within a Gentrifying Village	Dr Martin Phillips, Department of Geography, University of Leicester	mpp2@le.ac.uk
Achieving Sustainable Catchment Management: Developing Integrated Approaches and Tools to Inform Future Policies	Professor Clive Spash, Socio-Economic Research Programme, Macaulay Institute	c.spash@macaulay.ac.uk
Learning and Research for Sustainable Agro-Ecosystems by both Farmers and scientists	Dr Fergus Lyon, CEEDR, Middlesex University	f.lyon@mdx.ac.uk
Integrated Modelling and Assessment of Agricultural Sustainability - Scoping How to Support Policy Relevant Assessments of Agricultural Sustainability	Dr Keith Matthews, Landscape Change, Macaulay Institute	k.matthews@macaulay.ac.uk
Sustainable Upland Management for Multiple Benefits	Dr Klaus Hubacek, Leeds Institute for Environmental Science and Management, University of Leeds	hubacek@env.leeds.ac.uk
Integrating Spatial Data on the Rural Economy, Land Use and Biodiversity	Dr Piran White, Environment Department, University of York	pclw1@york.ac.uk
RELU: The International Context	Professor David Raffaelli, Environment Department, University of York	dr3@york.ac.uk
Development of a Rural Economy and Land Use Simulation Modelling Strategy	Dr Robin Matthews, Landscape Change, Macaulay Institute	r.matthews@macaulay.ac.uk
A Review of Recent and Current French Initiatives in Rural Economy and Land Use Research	Professor Henry Buller, Centre for Rural Research, University of Exeter	H.buller@exeter.ac.uk
Soils - the Foundation of the Rural Economy?	Dr Christine Watson, SAC, Crop and Soil Management	c.watson@ab.sac.ac.uk
Calming Troubled Waters: Making Interdisciplinary Work	Dr Sandra Bell, Department of Anthropology, University of Durham	sandra.bell@durham.ac.uk
Learning from the South: Mixed Farming in Stressed Environments	Dr Chasca Twyman, Department of Geography, University of Sheffield	C.Twyman@shef.ac.uk
Landscape as an Integrating framework for Rural Policy and Planning	Professor Paul Selman, Department of Landscape, University of Sheffield	p.selman@sheffield.ac.uk

VIEWPOINT

A LAND MANAGER'S PERSPECTIVE

Mark Tinsley

The decoupling of subsidy from production will in time reduce the amount of land within the UK on which food is produced. There will be much greater market focus and production will take place only if there is a good chance of the relevant financial output exceeding costs of production. Why will it take time for this to occur? Firstly, land managers get pleasure out of successful production and secondly a decision to stop producing with its associated farm infrastructure removal is not easily reversed by the individual involved. In one way or another, unit size will continue to increase and we must not put political barriers in the way of ever greater efficiency on land that can produce economically. However, my original statement stands, less land will be capable of commercially producing food. Do we have a strategy in the UK to deal with the land which will come out of production? What are our objectives for this land

Strategically economists argue that there is not a requirement for food to be grown in the UK; we could fulfil our requirements by importing. Would that extreme approach be wise? What effect would that have on our landscape, on diversity, on rural social policy? What chance would there be of recreating a competitive food production industry in the UK if we allow our UK farming base to become economically insignificant? The Curry Commission (2002) decided not to put a figure on the level at which we should be producing our own food. However the Commission felt that, whilst recognising the increasing importance of other rural outputs such as tourism, sport and flood protection, we should recognise that agriculture will continue to be the cornerstone of rural policy for the foreseeable future. Jonathon Porritt (2005) at the Oxford Farming Conference said "food production must be at the heart of farming. The rest is additionality. We need to protect a strong self-reliant food base in the UK." Projected population increase, pressure on water resources and unpredictable political ebbs and flows indicate that it would be fool hardy to downsize UK food production too far. We are blessed with a maritime climate; we should make the most of that comparative advantage. Globally water will be the major limiting resource. Economically, if we reduced food production in the UK, tax payers would be paying a similar amount to help producers in other EU countries and the balance of payments deficit would be substantially aggravated.

So post 2005, what will our landscape look like? There is already a rapid decline occurring in the UK dairy industry. Predominantly livestock land will be more extensively farmed and will look less well manicured. Substantial areas of the less productive arable land will not be producing food. Theoretically, such land must be kept in "good heart" but we believe that will only require the "land manager" to top growth one in every five years. There will be little incentive to maintain this landscape beyond minimum requirements. We shall see a continuing increase of size of farm unit through

sale, amalgamation, or contract farming. It is again important that political barriers are not put in the way of this. If we do try to restrict unit size we shall only make less land commercially competitive.

If these issues cause concern, we can be positive about the introduction of the Entry and Higher Level Schemes. I have not yet seen conditions of entry to these schemes after the pilots but hopefully they will be flexible enough to encourage a proliferation of features in the context of an area's indigenous background. For example, in our fens and marshes of south Lincolnshire on the land we manage we hope to introduce more ponds, scrapes and reedy areas rather than more hedges and trees. We shall see a massive increase of field margins being taken out of production and indeed "difficult" production areas or parts of fields similarly left uncropped. Do we have the knowledge to make the most of these uncropped areas? I suspect only in part. The cost of management of these areas will, I believe, exceed the £30/ha Entry Level Scheme payment over the whole farm but land managers like the idea of being paid to be positive environmentally. Hopefully 10 years or so from now the UK tax payer will be equally positive. We must not deny the opportunity to manage these uncropped areas using modern safe science. For example knapsacking noxious weeds is a nonsense on our fertile fens. Uncropped areas will need to be managed with all available technology. To really benefit wildlife, a range of measures will be needed. Intelligently designed flood protection zones will be important and must be encouraged.

In my view DEFRA have tackled the first parts of CAP Reform well. The next two years will be just as demanding. The key to success is recognising that land managers, as other people, react to incentives, predominantly financial, but equally the importance of recreation pursuits, such as country sports, must not be underestimated. In return land managers must recognise that tax payers will need an incentive to continue funding environmental enhancement. Also at this year's Oxford Farming Conference Lord Whitty (2005) pointed out the need for farmers to understand that there is no consensus among the electorate to subsidise food production. "The new Single Farm Payments (SFP) arrangements are a compact with the people for farmers to deliver the rural environment. Increasingly the industry will need to justify these payments by demonstrating the results. They can do this by being more open about the subsidy system, by enthusiastically welcoming increase access to land and by getting out and about in the community more, particularly getting into schools". In a practical sense I believe this means that we shall need to widen the access possibilities put in place by the CROW. Hopefully landowners will do this voluntarily rather than having it imposed.

What else will we do with the unproductive land? My personal view is that we shall quite quickly reduce the area of cereals we produce resulting in little or no exportable surplus from the UK. Thousands of hectares therefore will no longer produce food but ideally will need to be farmed to be kept in good heart. This is why we must encourage non-food crops for biomass, bio-fuels and bio-packaging etc. In the brief life of our Commission we did not adequately cover this, in part because as we all know the energy equations for such production are not positively balanced. There are however other advantages gained from growing non-food crops in terms of the environment

and potentially, rural communities and their relationship with urban neighbours, through for example community heating schemes. Aesthetically well maintained farm land and bio-mass production will be more pleasing than fallow or natural regeneration. Our maritime climate should be excellent for biomass production particularly. Jonathon Porritt again at Oxford “there are very significant opportunities for farmers in climate friendly land use practice”.

A few final points before concluding.

What is perhaps deliberately forgotten is why the UK has never accessed its relevant share of Pillar 2 funding. Such access triggers a related loss of rebate and a matched 50/50 EU Government spending scenario becomes a 25/75 situation. That is a major disincentive for the UK Treasury and a big problem for the rural economy.

We also have a major transport infrastructure problem in the UK which successive Governments have refused to deal with. We must get to grips with transport realities and in this context, as with nutrition, Government must take a long-term view and govern. We should not try to preserve our rural landscape in aspic; change is an essential part of inevitable progression.

We need to be circumspect about local food sourcing and the importance of such direct retail outlets as farmers markets. Production has and will be carried out where the resources for that production are most suitable. It is the cost/unit of food sold or the CO₂ produced in the chain from farmer to plate that is important, not necessarily the distance between farm and market. To increase significantly further direct sales of food would need a massive investment in infrastructure which would only replicate what the major UK retailers are already doing. When we refer to local food production, we should be thinking UK and do whatever we can to create a positive consumer mindset towards the highly regulated UK food industry. That does not stop us identifying, on the retail shelf, better production areas and producers in the UK. We need to tell the “story” of food production.

Beware of single issue pressure groups bearing bad news. We should welcome them as part of our democratic controls, but have a healthy disrespect for any organisation which ignores both sides of an argument. I do accept that food production had become disconnected from its consumers and that has to be reversed. A final quote from Jonathon Porritt (2005) “fair trade cuts both ways. We must not export all the undesirable externalities to countries with lower standards. And we cannot leave the subtleties of this to consumers – it needs legislation.”

Finally, we must do what we can to make sure that the bulk of land which continues to produce food is allowed to do so competitively. Whilst accepting there is a demand for organically produced food, at the same time remaining extremely sceptical about its supposed benefits, an integrated approach to farming - combining time honoured principles with safe up to date science - is the way forward for most food production.

In conclusion, we have an opportunity to create a much healthier and more vibrant rural scenario. We must grasp it. There is a great requirement for intelligently focussed research based on scientific evidence rather than

political whim.

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Biographical Notes

Mark Tinsley is the Managing Director of PC Tinsley Ltd. He grows fresh produce, primarily for retail sale, and is passionate about combining profitable business with environmental care. Mark was a member of the Policy Commission on the Future of Farming and Food, and is a member of Food Chain Centre Steering Group. Among his many other interests, he is Chairman of Nene Potatoes Ltd and a member of Commercial Farmers Group.

ABSTRACTS

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208 LEEMING, J.; TURNER, P. **The BSE crisis and the price of red meat in the UK.** *Applied Economics* (2004) **36** (16) 1825-1829 London, UK; Routledge [En, 8 ref.] Department of Economics, University of Sheffield, 9 Mappin Street, Sheffield S1 4DT, UK. Email: p.turner@sheffield.ac.uk

This paper presents estimates of price functions for beef, lamb and pigmeat for the UK economy, which allow for the effects of the 1996 bovine spongiform encephalopathy (BSE) crisis. The estimates illustrate the importance of allowing for the joint endogeneity of prices in these markets. It is shown that the BSE crisis had a significant negative effect on the price of beef and a positive and significant effect on the price of lamb. However, there appears to have been little effect on the price of pigmeat.

216 LIGHT, F. O. **Estimate of European beet sugar production 2004/05.** *International Sugar Journal* (2004) **106** (1270) 536-538, 540 Tunbridge Wells, UK; Agra Europe (London) Ltd [En, de, es] Am Mühlengraben 22, 23909 Ratzeburg, P O Box 1220, Germany.

Sugar production in the enlarged EU in 2004/05 could remain almost unchanged from the previous year. However, export revenues will rise due to higher global prices. The future of the EU sugar industry is bleak given the threat of hefty price and quota cuts. It seems as if in the longer term the EU will no longer be a force on the world market with Brazil conquering most of the gap left. Despite assurances to the contrary, this is likely to increase market volatility and sugar could share coffee's fate in a few years hence. Outside the EU small improvements are expected for the Russian and Ukrainian industries although the hurdles to further progress remain immense. The sugar industry in Serbia seems to be back on track with higher production and exports forecast for 2004/05. Turkey is likely to be self-sufficient this season after years of surplus production. The industry will become more efficient as a result of the privatization process. In general, Europe could be a refuge of stability in a volatile world sugar market.

348 FRANCIS, C. A. **Greening of agriculture for long-term sustainability.** *Agronomy Journal* (2004) **96** (5) 1211-1215 Madison, USA; American Society of Agronomy [En, 11 ref.] Agron. and Hortic. Dep., Univ. of Nebraska, Lincoln, NE 68583-0915, USA. Email: cfrancis2@unl.edu

Consolidation and growth of large corporations in US agriculture are facing increasing scrutiny from a consumer public with growing awareness of environment issues. More people in society now question not only where food is grown and what types of practices impact the environment, but how the benefits are distributed. Although driven by short-term economics in many purchasing decisions, consumers are asking whether we could continue our standard of living while maintaining the natural resource base and not polluting the environment. Agricultural corporations are responding to this consumer concern by greening some of their operations and especially greening their images. Is this a real conversion in methods and products or merely a "greenwashing" of the corporate image? Large corporations face economic, environmental, and social challenges in their quest for an improved image. Examples in five major areas illustrate the impacts of corporate agriculture: industrial organic food production, consolidation of farms, genetically modified organisms, global food systems, and unregulated capitalism and limited-liability corporations. Each is related to structural conditions in agriculture, and each must be addressed by corporations that are serious about improving their images with consumers. To deal with these issues that impact both farmers and consumers, positive alternatives to conventional mainstream business approaches are discussed.

349 RAO, N. H.; KATYAL, J.C.; REDDY, M. N. **Embedding the sustainability perspective into agricultural research — implications for research management.** *Outlook on Agriculture* (2004) **33** (3) 167-176 London, UK; IP Publishing Limited [En, 38 ref.] National Academy of Agricultural Research Management, Rajendranagar, Hyderabad 500 030, India. Email: nhrao @naarm.ernet.in

Concerns for long-term food security and the sustainability of agriculture are forcing international and national agricultural research organizations to reorient their research goals, programmes and projects to ensure that the sustainability perspective underlies all of them. This requires a major paradigm shift in agricultural research planning and management. This paper develops an analytical framework for agricultural research management that can guide a transition from research directed towards productivity goals alone to that which addresses productivity issues, keeping sustainability concerns in sight. The framework is built on a realistic assessment of food demands and supplies, trade-offs between agricultural production increases and the quality of the natural resource base, the capabilities of emerging technologies and the overall profitability of agriculture. The development of such a framework is illustrated by considering the situation in India as a case study. It is suggested that, in the Indian context, embedding sustainability concerns into agricultural research requires interactions between research with a cropping systems perspective at the farm level, a regional natural resource management perspective with a relatively short-term focus on profitability, and a longer-term focus on environmental health at the agroecosystem level. The implications for management of such research are discussed.

358 ZILBERMAN, D.; LIU, X. M; ROLAND-HOLST, D.; S, D **The economics of climate change in agriculture.** In *International Conference on Climate Change and Environmental Policy., University of Illinois at Urbana-Champaign, USA, November 2002. [Edited by Kheshgi, H. S.; Khanna, M.]. Mitigation and Adaptation Strategies for Global Change* (2004) **9** (4) 365-382 Dordrecht, Netherlands; Kluwer Academic Publishers [En, 20 ref.] Department of Agricultural and Resource Economics, University of California, Berkeley, California, USA.

This paper presents a conceptual framework of the impact of, climate change on agriculture. It assumes that climate change will result in a fertilization effect and a shift of agro-ecological conditions away from the Equator towards the Poles. The agro-ecological shift is likely to reduce yield because of reduced acreage and the fertilization effect will increase yield. The aggregate effect depends on whichever of the two dominates. The overall effect of climate change may be less significant than its distributional effects and the results are consistent with previous empirical studies. The impact of climate change depends on its pace. Faster changes in climate will result in higher cost. The assessment of the cost has to consider that climate change is a dynamic phenomenon that may require continuous adjustment. Environmental regulation that emphasizes conservation may increase cost of adjustment and environmental policies should emphasize adaptation and flexibility.

387 WIGHTMAN, A. **Hunting and hegemony in the Highlands of Scotland: a study in the ideology of landscapes and landownership.** *Noragric Working Paper* (2004) No.36, 26 pp. As, Norway; Noragric, Agricultural University of Norway, Centre for International Environment and Development Studies [En, 35 ref.] 9 Inverleith Terrace, Edinburgh, EH3 5NS, UK. Email: andywightman@caledonia.org.uk

This paper reviews and explores the role of hunting estates in the creation and propagation of an ideology of the Highland landscape in Scotland. It seeks to understand a number of thematic debates that have contributed towards a re-assessment of the role of the hunting estate and its hegemonic status in the division and use of land in the Highlands and Islands. In particular, the paper explores the changing face of the hunting estate, how it is constructed, and the discourses surrounding its role, purpose and character. The paper concludes by arguing that the era of the Highland Sporting Estate may be ending, that new imperatives in rural development and community empowerment are hastening this demise, and that public policy has failed to address the role and purpose of such landholdings.

1346 Newton, J. **Profitable organic farming**. Oxford, UK-Blackwell Science Ltd (2004) Ed.2, xv + 176 pp. ISBN 0-632-05959-1 [En]

This book covers every aspect of an organic farming enterprise that can influence profitability including grassland productivity, production systems for dairy, beef, sheep, pig, poultry and arable farms, farm size and enterprise combinations, organic standards, financial management, marketing, success factors, progress by organic farmers, and potential future scenarios for organic farming. It is aimed at a wide audience including organic farm managers, agricultural scientists and students, and those in government and regional agricultural advisory services.

1458 NIEHOF, A. **The significance of diversification for rural livelihood systems**. *Food Policy* (2004) **29** (4) 321-338 Oxford, UK; Pergamon Press [En, 42 ref., Special issue: Less-favoured areas] Sociology of Consumers and Households Group, Mansholt Graduate School of Social Sciences, Wageningen University, Hollandseweg 1, 6706 KN Wageningen, Netherlands. Email: anke.Niehof@wur.nl

There is an increasing awareness that diversification plays a strategic role in rural livelihood systems. The principal question addressed in this paper pertains to the conditions and the ways in which rural households diversify their livelihood activities and strategies. To answer this question empirical evidence is reviewed. Specific attention is paid to perspectives that may shed new light on the issue of rural livelihood diversification: a gender perspective, a temporal perspective, and the 'HIV/AIDS lens'. In the paper, the livelihood system is seen as an open system, interfacing with other systems and using various resources and assets to produce livelihood, with the household as the locus of livelihood generation. Diversification is defined as the process by which households construct increasingly diverse livelihood portfolios, making use of increasingly diverse combinations of resources and assets.

1571 MAYER, S.; STIRLING, A. **GM crops: good or bad? Those who choose the questions determine the answers**. *EMBO Reports* (2004) **5**(11) 1021-1024 London, UK; Nature Publishing Group [En, 30 ref.] GeneWatch UK in Tideswell, Derbyshire, UK. Email: sue.mayer@genewatch.org, a.c.stirling@sussex.ac.uk

There has been intense debate on the rationality of the public's attitude towards genetically modified (GM) crops. However, despite the heated claims that have been brought forward from both sides in the GM debate, the views of the public are seldom taken into account or investigated more closely. This paper discusses the differences in viewpoints on GM crops.

1740 CORFEE-MORLOT, J.; AGRAWALA, S. **Special issue: The benefits of climate policy**. *Global Environmental Change* (2004) **14** (3) 195-297 Oxford, UK; Pergamon Press [En, Special issue: The benefits of climate policy]

This special issue contains 10 papers which cover a wide range of assessments of the human and policy dimensions of climate change. The issue is organized in three parts. The first part provides a review of literature on the sectoral and regional impacts of climate change, with the aim of informing the discussion on benefits. The second part consists of a trilogy papers that address key analytical issues relevant to the discussion on benefits, but which are not explicitly accounted for in the global impact assessments. The third part consists of two broader reflections or viewpoints on the entire discussion on global mitigation policy benefits.

1849 SHELTON, D. **Diversification in agricultural engineering**. *Landwards* (2004) **59** (5) 2-4 Silsoe, UK; Institution of Agricultural Engineers [En] Shelton Sportsturf Drainage Solutions, Baumber House, Baumber, Horncastle, Lincolnshire, LN9 5NF, UK. Email: sheltons@baumberhouse.fsnet.co.uk

This paper presents 2 examples of diversification: (1) farmer/horticulturist diversifying into agricultural engineering; and (2) 100-year old smithy diversifying or evolving into the leisure industry. The innovation, market niche, and business aspects of some farm machineries are also described, including the Shelton Gravel Band Drainer, a trenchless system for installing

secondary drainage in sports fields and golf courses, the Shelton Super-trencher and the Shelton 4-wheels-in-line High Lift Trailer.

1866 ROSATI, A.; AUMAITRE, A. **Organic dairy farming in Europe.** In *Trends and developments in organic livestock farming systems. IXth WCAP congress, Porto Alegre, Brazil, 26-31 October, 2003.* [Edited by Hermansen, J. E., Zervas, G.J. *Livestock Production Science* (2004) **90** (1) 41-51 Amsterdam, Netherlands; Elsevier Science B.V. [En, 27 ref., EAAP Publication No. 1/2004] [European Association for Animal Production, Via Nomentana 134, 00162 Rome, Italy. Email: aumaitre@st-gilles.rennes.inra.fr]

Organic milk production has gained importance in Europe. The European Union introduced regulations to standardise organic reduction throughout all member countries. The market for organic products is constantly increasing and still has not reached market stability. The differential price of organic products could maintain farms in marginal environments. In many cases, the market is still encouraging as the limit seems to be the availability of organic products. There is a large body of research comparing organic and conventional livestock farming systems, but most of them ignore local and specific factors. Different feeding systems characterise organic and conventional farming. Limits of the use of concentrates in the feed ration diminish production levels of milk. Quality of dairy products has not been changed in European dairy farming by the application of organic regulations. The more natural dairy management in organic farms is felt to improve animal welfare and animal health. However, reality does not always resemble this common belief. A greater use of pasture vs. more intensive dairy system for conventional herds certainly improves animal welfare, but because of the limit to drug use in organic systems animal health is not always enhanced. Organic farming systems are more "environment-friendly" than conventional management, especially for the lower eutrophication potential of organic herds. Nevertheless, in organic production, the same amount of milk is obtained by exploiting a larger area of pasture.

1980 CECH, T. V. **Principles of water resources: history, development, management, and policy.** Chichester, UK; John Wiley & Sons Ltd (2004) Ed.2, xx + 468 pp. ISBN 0-471-65810-3 [En, many ref., Price: £32.95]

This second edition covers topics on the history of water availability and use, as well as government development, management and policy of water usage. The book contains 15 chapters: Historical perspective of water use and development; The hydrologic cycle, climate, and weather; Surface water hydrology; Groundwater hydrology; Water quality; Municipal and irrigation water development; Dams; Water allocation law; Federal water agencies; Local, regional, state and multistate water management agencies; Drinking water and waste water treatment; Water, fish, and wildlife; The economics of water; Water use conflicts; and Emerging water issues.

1983 MACMULLAN, J.; PENDLETON, A. **Taking liberties: poor people, free trade and trade justice.** London, UK; Christian Aid (2004) 65 pp. [En, many ref.] Christian Aid, UK.

This book looks at the impact of trade policies forced upon poor people in developing countries by rich nations and global institutions, and finds that they need trade justice rather than free trade. Stories from poor communities show the devastating impact that inappropriate free trade policies have had in the past 20 years. The book also looks in detail at three case studies from India, Mozambique and Honduras where trade policies to safeguard the interests of poor people have been chosen in the milk, sugar and rice industries, respectively.

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EDITORIAL

This issue's opening paper demonstrates the useful information that can be gleaned from modelling policy change. It examines the combined impacts of the Mid Term Review and environmental legislation on dairy farm profitability in Ireland. Thia Hennessy and her colleagues apply several scenarios to the well-respected FRAPI-Ireland Farm Level Model to reveal outcomes that might be expected on a standard farm subject to assumptions about future prices and yields. It is an excellent example of the insights that can be derived from models of complex change.

The following paper analyses the competitiveness of cereal production between selected European Union member states. Thorne shows that productivity varies between member states, but concludes that it is the opportunity cost of owned resources that is the most significant determinant of competitiveness: that is the value of assets in some other activity. This is a timely reminder in the context of farmers' business decisions in the context of decoupled payments "as producers must make production decisions based on full economic costs of production". This conclusion has wider implications; it should be used to calculate payments for participating in agri-environmental schemes rather than the current calculation which relies largely on agricultural income forgone.

UK farms tend to be family run and owner-occupied, and are it seems forever being urged to co-operate more with one another (Policy Commission 2002) which it appears an increasing number of farmers are starting to do (see for example the English Food and Farming Partnership (EFFP) case studies of co-operation (EFFP 2005)). Russian farm structure and agriculture policy are different and pointing in a different direction. The basis of the farm business structure remains the co-operative but following government incentives and encouragement a small population of family farms has emerged. The paper by Franks and Davydova, and their colleagues from the University of Novosibirsk, Siberia, examines the different approaches to hiring and firing, planning and allocation, buying and selling and lending and borrowing adopted by collective and private farmers in Novosibirsk oblast.

Dame Deirdre Hutton was invited to present last year's Mary Edith Gayton Lecture at the University of Reading and her paper is reproduced here. Dame Deirdre is well placed to discuss the importance of reconnecting consumers with agriculture as Chair of the Food Standards Agency, and *inter alia* a member of the Policy Commission on the Future of Farming and Food. There are many reasons why agriculture needs to bridge the gap between producer and consumer, and many strategies for doing so: read on to discover Dame Deirdre's views.

One of the activities supported by the Institute is the biannual conference of farm management lecturers. Graham Tate led the organisation of the most recent meeting at Harper Adams University College and his and colleagues' review of the two day conference is most welcome.

Jeremy Franks
Editor

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www.cabinet-office.gov.uk

REFEREED PAPER

**THE ECONOMIC IMPLICATIONS OF COMPLYING WITH
A LIMIT ON ORGANIC NITROGEN IN A DECOUPLED
POLICY ENVIRONMENT – AN IRISH CASE STUDY**

T. Hennessy, L. Shalloo and P. Dillon

This paper assesses the implications for farm profitability of complying with environmental legislation. Economic modelling is used to determine the effect of introducing a limit on organic nitrogen (N) of 170 kg/ha on a dairy system and farm profit. Analysis using Irish data shows that 30 percent of specialist dairy farms and 21 percent of mixed dairy farms are affected by the organic N limit. The results show that the imposition of a limit on organic N in conjunction with a lower milk price as agreed under the Mid Term Review of the CAP is likely to negatively affect farmers who plan to expand production to offset the impending price cost squeeze. The impact of the organic N limit on farm profit is largely dependent on the farm's stage of development as expanding farms experience greater losses. A case study is used to illustrate the effect of imposing a limit on a whole farm basis: average farm profit reduces by 5 percent but if the limit is enforced on a field-by-field basis then the reduction in farm profit is much greater.

Key words: dynamic profitability, MTR, environmental regulations, nitrogen limits, dairy farming, Ireland.

Introduction

The Mid Term Review (MTR) of the Common Agricultural Policy (CAP) has allowed for the decoupling of all direct payments from production and the reduction of the intervention prices for the main dairy commodities. Compensation for the price reductions is payable but is decoupled from production. Economic studies have indicated that the actual return to dairy production, that is excluding the decoupled compensation, will fall significantly as a result of the policy reform and that many dairy farmers may exit production once they have qualified for compensation.¹ In an environment constrained by milk quota, the exit of some producers presents the opportunity for expansion for those remaining.

However, the implementation of the Nitrates Directive (91/676/EEC) will result in a limit on organic nitrogen (N) per hectare (ha) and in effect, limit stocking density. This may constrain farmers' expansion potential and hence the economic implications of this environmental legislation may be more negative than previously anticipated when it is considered in conjunction with the MTR. A number of studies have been undertaken to estimate the economic impact of environmental regulations on dairy farms (Berensten *et al.* 1992; Berensten and Giesen 1995; Rigby and Young 1996; Lally and Riordan 2001). Berensten *et al.* (1992) showed that on Dutch dairy farms, severe manure legislation caused a reduction of Dfl. 244/ha on extensive farms and up to Dfl. 532/ha on intensive farms. Rigby and Young (1996) simulated the impact of European environmental regulations on a group of 23 UK dairy farms. A 210 and 170kg/ha organic N limit resulted in a reduction in animal numbers in one

1. See for example Harvey and Colman (2003) for an analysis of the UK dairy sector, Peerlings and Ooms (2005) produced projections for the Dutch dairy farming sector and Shalloo *et al.* (2004a) and Breen *et al.* (2005) for results for Ireland.

and thirteen farms respectively. In most cases, the necessary herd number reductions were small, however they did observe that any EU policy that used a single variable such as stocking rate or N application rate as a proxy for pollution threat runs the risk of being inaccurate. In Ireland, Lally and Riordan (2001) indicated that the EU Nitrates Directive using a limit of 170kg/ha organic N would affect 39 percent of specialist dairy farmers in a selected study area. The results indicated that a farm with an initial organic N output of 220kg/ha would experience a 15 percent drop in farm income whereas a farm with an organic N output of 195kg/ha would experience a 9 percent drop in income through conforming to the organic N limit of 170kg/ha. The results also indicated that income losses could be offset by increasing the efficiency of nitrogen use, or by increasing milk production per cow. However, the more a farm was above the 170kg/ha of organic N (2 cows/ha) the larger the potential loss of income and the more difficult it would be to make good this loss.

This paper uses the case study of Ireland to explore the economic implications of the imposition of a limit on organic N in the context of a reduced milk price and decoupled direct payments.² The paper begins by providing a background to the MTR as it is implemented in Ireland, and the Nitrates Directive. The first part of the results section considers the implications of the Nitrates Directive for the dairy farming population in Ireland. The economic cost of complying with a limit on organic N is estimated first in a static scenario, that is a scenario that assumes that farmers do not change their current farm plan or animal numbers, and then in a dynamic scenario, which considers the effect of the directive on *developing* farms. In the next section, case study farms are used to determine the effect of different implementation strategies of the Nitrates Directive (whole farm or field by field) on the overall farm system and farm profitability. The paper concludes by commenting on the effect of environmental legislation on the viability of dairy farming.

Background

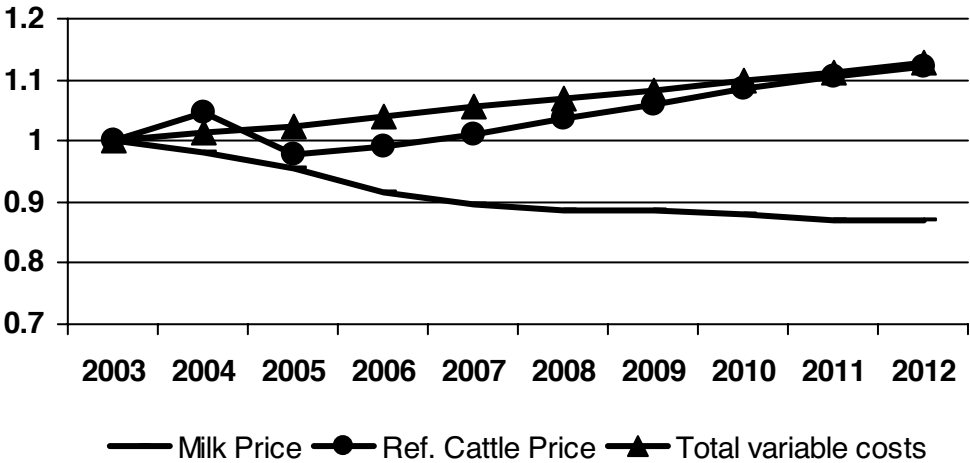
In Ireland all direct payments have been decoupled from production from January 1, 2005. From this date, a farmer's Single Farm Payment is a function of the number of direct payments claimed in the reference period, i.e. 2000, 2001 and 2002. Prior to the MTR, most direct payments were coupled to production and therefore farmers were required to grow crops or stock animals to qualify for support. With decoupling, farmers will receive these payments regardless of production levels as long as land is maintained in accordance with good farming practice. Milk quotas will be retained to 2015, but there will be substantial changes to the intervention scheme for dairy products. The intervention prices for butter and skim milk powder will be reduced by 25 and 15 percent respectively over a three-year period beginning in 2004. Producers will be compensated for these price reductions, at a rate of €11.81/tonne in 2004, €23.65/tonne in 2005 and €35.5/tonne from 2007 onwards, this compensation will be decoupled from production from 2005.

2. Other effects from the nitrates directive such as increased slurry storage requirements and increases in the closed periods are not quantified in this paper.

Binfield *et al.* (2003) have used econometric modelling to estimate the effect of the MTR on the main commodity and agricultural input markets in Ireland. Figure 1 shows projections of prices and costs under the MTR. Milk price is projected to decline by almost 20 percent in nominal terms in the ten-year period to 2013. Simultaneously, total variable costs are projected to increase by over 10 percent indicating that dairy farmers will face a price-cost squeeze.

Studies of the implications of the MTR at farm level show that major

Figure 1. Projections of Milk and Beef Prices and Total Variable Costs.



restructuring is likely in response to this price cost squeeze and to maintain their incomes in real terms, dairy farmers will have to make major efficiency gains and or expand production (Harvey and Colman 2003, Shalloo *et al.* 2004a and Breen *et al.* 2003). These studies show that mixed dairy farms can maintain profit by replacing non-dairy livestock with dairy cows. In a decoupled environment, the disposal of non-dairy livestock may not result in significant financial losses as the direct payments previously accruing to these animals are still retained.

In addition to the MTR, farmers must also prepare for the enforcement of EU environmental legislation. The Nitrates Directive (91/676/EEC) was introduced by the EU in 1991 to address the problem of water pollution, which was perceived to be induced by nitrates from agricultural sources, with the objective of preventing further pollution. The directive states that ‘the amount of livestock manure applied to land each year, including by the animals themselves, shall not exceed a specified amount per hectare, the specified amount being the amount of manure containing 170kg/ha of organic N, (OJEC, 1991, 91/L375/EEC;7). EU member states were given a number of years to implement the Directive. Taking Ireland as a case study, this paper explores the economic implications of imposing this environmental legislation in conjunction with the MTR.

Methodology

Irish National Farm Survey data from 2002 and organic N production figures per head of animal (DAFF, 1996) are used to estimate the total number of farms nationally that exceed the 170kg/ha limit of organic N.³ For each farm that is in breach of this limit, the cost of compliance is estimated for static and dynamic scenarios. The static (status quo) scenario analysis shows the cost of compliance assuming that farmers continue as normal, do not change their farm plans or animal numbers. First, the numbers of animals that must be removed from the farm to comply with the Nitrates Directive are calculated; then the profit accruing to the least profitable animals is deducted from the family farm income (FFI).

To show the true cost of compliance, it is important to consider the effect of the nitrates directive in the context of a dynamic scenario where dairy farmers might expand production. Therefore, compliance costs in a dynamic scenario are also estimated. Earlier research by Breen and Hennessy (2003) used the FAPRI-Ireland farm level model to produce projections of the number of farmers in dairy production and their levels of production in 2007 and 2012 are available.⁴ For each of these farms, farm plans in 2007 and 2012 are simulated using the FAPRI-Ireland farm level model. The number of animals that must be removed from these farms to comply with the organic N limit is estimated and the associated loss in income is calculated.

To consider the effect of the nitrates directive at farm level, a case study farm which is based on the average specialist dairy farmer using 2002 NFS data is used. Case studies are examined using the Moorepark Dairy Systems Model, which is a stochastic budgetary simulation model of a dairy farm (Shalloo *et al.* 2004b).⁵ Table 1 shows the physical inputs included in the model, which correspond to the average specialist dairy farmer. All analysis was carried out under the assumption that milk quota was fixed at farm level (expansion was not possible). The farm size of 52 ha is predominantly in permanent grassland and contains both the dairy enterprise and 32LU of beef. Within the decoupled environment it was assumed that the profitability of the beef operation would return €260/ha based on FAPRI projections (Binfield *et al.* 2003). Therefore land can enter and leave the dairy enterprise for €260/ha.

Table 1. Key herd parameters in Case-Study analysis.

	Default
Land area (ha)	52.2
Cow numbers	54
Quota size (l)	243 400
Milk sold per cow (l)	4643
Milk quota lease costs (c/l)	3.7
Opportunity cost of land (€)	260
Average number of beef units	32

3. The Irish National Farm Survey is a member of FADN the farm accountancy data network of Europe. It surveys approximately 1200 farms annually that are weighted to represent the total population of over 100,000 farms.

4. A detailed explanation of the FAPRI-Ireland farm level models is available in the technical annex.

5. A detailed explanation of the Moorepark Dairy Systems model is available in the technical annex.

Farm net profit is simulated for the average specialist dairy farmer in four categories based on an organic N output of 250, 230, 210 and 170kg/ha. The effect of an organic N limit of 170kg/ha is simulated for the four categories of specialist dairy farmers using the case study farm model. The implementation of the Nitrates Directive is investigated for two scenarios. In first scenario (S1) it is assumed that the Nitrates Directive is implemented at the farm level and the model is simulated where the farm is in one grazing block. The implementation an organic N limit of 170kg/ha resulted in an increased requirement for land at an opportunity cost of €260/ha. In the second scenario (S2) it is assumed that the Nitrates Directive is implemented on a field-by-field basis assuming a fragmented farm where a reduced organic N limit results in a reduction in cow numbers and undelivered milk quota is leased from the farm at 3.7c/l. Under the current National Action Programme it is proposed that there will be no organic N restriction until the 31 December 2006, therefore all modelling includes years 2007 to 2011.

Results

Compliance in a Static Scenario

Table 2 shows the number and percentage of farmers exceeding the 170kg N/ha limit in 2002.

Table 2. Number of farmers less than and exceeding an organic N limit of 170 kg/ha.

Farm system	<170 kg N/ha		>170 kg N/ha	
	Farms	%	Farms	%
Dairy Specialist*	13 234	70	5 641	30
Dairy and other	9 974	79	2 518	21
Cattle Rearing	31 052	98	597	2
Cattle finishing	26 433	97	744	3
Sheep	19 968	98	434	2
Mainly Tillage	6 714	100	-	-
Total	106 378	91	9 937	9

*Dairy specialists are farms with over 66% of the standard gross margin from the dairy enterprise.

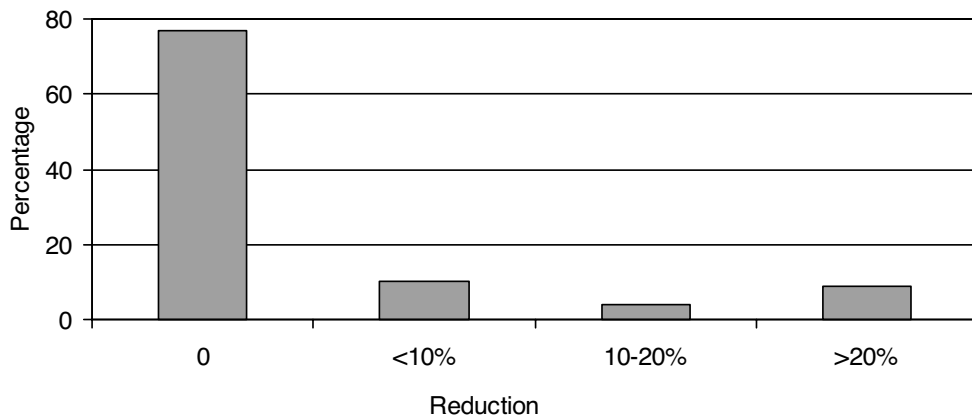
Source. Irish National Farm Survey Data (2002)

Less than 10 percent of Irish farmers are in breach of the 170kg limit. Approximately 70 percent of specialist dairy farms and 79 percent of mixed dairy farms are in compliance with the 170kg/ha limit. The cost of compliance with the Nitrates Directive in 2007 is considered for Irish dairy farmers. Using the price and cost projections presented in Figure 1. Family farm income in 2007 is calculated for a scenario where farmers can maintain their current animal numbers and stocking rates, i.e. no N limits apply. This estimate of income is compared to one where farmers exceeding the limit must dispose of animals to become compliant. The post decoupling profit per animal is estimated. For farmers exceeding the limit, it is assumed that they dispose of the least profitable enterprise; less profitable non-dairy animals first and then dairy cows. Due to data restrictions, all dairy cows are assumed to have the same level of profitability. Calculations of the number of animals to be

disposed and profit per head are used to arrive at an estimate of compliance costs. The difference between these two income estimates shows the cost of compliance.

Figure 2 shows that approximately 78 percent of dairy farmers would be no worse off if the 170kg limit were applied. Results show that approximately 1,000 of the dairy farmers currently exceeding the 170kg limit could in fact comply with the limit in a post decoupling scenario at no cost.⁶ These farmers are currently operating a market loss making livestock enterprise on their farm, i.e. the costs of production exceed the market price and the enterprise is only continued to receive the coupled direct payment. In a decoupled situation, these farms benefit financially if they de-stock these market loss making animals but still retain the associated decoupled payment and they become compliant with the N limit in the process. The remaining 7,000 dairy farms experience some income loss as a result of the 170kg limit

Figure 2. Reduction in Family Farm Income of Dairy Farms complying with Organic N limit of 170 kg/ha in a static scenario by 2007.



Approximately 10 percent of farmers would be less than 10 percent worse off as a result of compliance with a 170kg limit. Eight percent of farmers would lose between 10 and 20 percent of their income through compliance while 5 percent would suffer income losses of 20 percent or more.

Compliance in a Dynamic Scenario

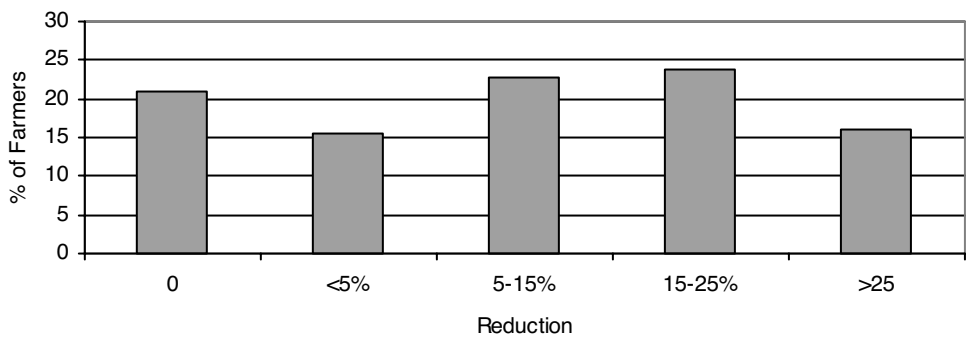
The MTR is likely to be an impetus for adjustment in the dairy farming sector and it is projected that it will result in milk quota becoming concentrated onto fewer farms with the overall effect of intensified livestock production. Under Agenda 2000 there were financial incentives in the form of direct payments to encourage low stocking densities. Farmers were obliged to stock less than 1.8 livestock units per hectare to claim direct payments and higher rates of payments were paid to those stocking less than 1.6 and 1.4 livestock units per hectare. The results of the FAPRI-Ireland farm level model

6.. There is no cost for these farms as far as they do not need to reduce animal numbers, however these farmers may suffer loss in future earnings because of the limit on expansion potential.

show that, other things being equal, farmers remaining in dairy production post decoupling, are likely to become more specialised in dairy production. As the decoupled payments available under the MTR are still coupled to land it is expected that even after decoupling, land rental prices are unlikely to fall considerably and the amount of land available for renting will be more or less unchanged. Therefore, other things being equal, dairy farmers increasing milk production will find it more efficient to increase stocking rates than to increase the area of land farmed. While limits on stocking rates or nitrogen may not initially affect income levels they are however, likely to result in substantial losses in future potential income. To show the true cost of compliance, the loss of future potential income must also be considered.

Projections of future dairy farm numbers produced by the FAPRI-Ireland farm level model, which is described in the technical annex, are used here to estimate the cost of compliance in a dynamic scenario. It is projected that there will be 21,000 dairy farms in 2007 with an average of 275,000 litres of milk production compared to approximately 28,000 producers with an average size of 220,000 litres in 2003, (Breen and Hennessy 2003). Due to the increased production per farm it is estimated that only 21 percent of dairy farms would go unaffected by a 170kg/ha organic N limit. Figure 3 presents compliance costs in this dynamic scenario for 2007. It is projected that incomes would decline by less than 5 percent on 16 percent of farms, while 23 percent of farms would lose between 5 and 15 percent. In a dynamic scenario where a 170kg/ha limit is applied in 2007, 40 percent of dairy farmers would lose more than 15 percent of income. Furthermore, the economic implications of the organic N limit are likely to exacerbate as time continues and as milk quota becomes more concentrated onto fewer farms.

Figure 3. Reduction in Family Farm Income of Dairy Farms complying with Organic N limit of 170 kg/ha in a dynamic scenario by 2007.



Case Study: Compliance with the Nitrates Directive on a farm basis

The effect of an organic N limit of 170kg/ha on a case study farm (modelled on the 2002 average specialist dairy farmer from the NFS) is considered, assuming that the farm initially has an output of various organic N levels (250, 230 and 210kg/ha). Table 3 shows the key parameters of the case study farm at the various organic N limits. Nitrogen application rates are

reduced in line with stocking rates based on nutrient advice for grassland (Teagasc 2004). Grass production is reduced based on the nitrogen application rates (Murphy 1978). Given the changes in grass production when the nitrogen application rates are reduced it is estimated that the farm area required for the dairy operation increases from 21.2ha at 250kg of organic N/ha to 31.2ha at 170kg of organic N/ha. If it is possible to increase the farm land area, the cow numbers and quantity of milk production does not change even when the organic N limit is imposed, however, there are compliance costs in terms of the opportunity cost of extra land.

Table 3. The relationship between mineral nitrogen input, grass production, land use and organic N loadings.

Mineral Nitrogen	Grass production	Land use	Organic nitrogen loading	Cow number
(kg N/ha)	(kg DM/ha)	(ha)	(kg N/ha)	(Nos)
375	15,937	21.2	250	51.2
300	14,119	23.0	230	51.2
235	12,431	25.2	210	51.2
150	10,018	31.1	170	51.2

Table 4 shows the effect of varying organic N loadings (250, 230, 210 and 170kg/ha) on farm profit for an average specialist dairy farmer from 2007 to 2011 (S1). Even when no organic N limit is imposed, farm profit declines for each category of organic N output from 2007 to 2011 as a result of the MTR, which is similar to the results reported previously (Shalloo et al. 2004a; Breen et al. 2003). Farm profit is similar for organic N limits of 250, 230 and 210kg/ha. The reduction in farm profit when a limit of 170kg/ha of organic N is imposed is approximately €2,000 each year. The true effect of the Nitrates Directive on farm income is dependent on the availability of additional land within grazing distance for the herd and the opportunity cost of that additional land.

Table 4. The influence of varying organic N limits applied at farm level on annual farm profit for 2007 to 2011.

Organic nitrogen loadings (kg /ha)	2007	2008	2009	2010	2011
250	38,390	37,413	37,348	36,959	36,408
230	38,329	37,352	37,287	36,898	36,347
210	38,123	37,146	37,081	36,692	36,141
170	36,568	35,591	35,526	35,137	34,586

Compliance with the Nitrates Directive on a field by field basis

Table 5 shows the influence of an organic N limit of 170kg/ha on key physical outputs applied on a field-by-field basis (S2) on a case study farm assuming that it currently has varying levels of organic N output (250, 230 and 210kg/ha). Compliance with the 170kg limit is achieved by reducing cow numbers and leasing out the additional milk quota at an assumed rate of 3.7c/l. Cow numbers are reduced by 16.4, 13.4 and 9.8 to comply with restrictions of 170kg/ha on farms with an initial organic N output of 250, 230 and 210kg/ha respectively. Milk output decreases by 74,573, 60,954 and 44,376l to comply with restrictions of 170kg/ha on farms with an initial organic N output of 250, 230 and 210kg/ha respectively.

Table 5. The influence of an organic N limit of 170 kg/ha applied on a field by field basis on key physical parameters on dairy farms with various organic N loadings.

Organic N output (kg N/ha)	Organic N Restriction (kg N/ha)	Farm area (ha)	Milk delivered (litres)	Cow number (Nos)
250	170	21.2	168,827	34.8
230	170	23.0	182,446	37.8
210	170	25.2	199,024	41.4
170	170	31.1	243,400	51.2

Table 6 shows the resulting farm profit when the organic N limit of 170kg/ha is imposed on farms that currently have an organic N output of 250, 230 and 210kg N/ha on a field-by-field basis. For farms stocked at 250kg/ha organic N, the imposition of the 170kg/ha limit reduces farm profit by between €8,193 and €7,685 each year from 2007 to 2011. For farms stocked at 230kg/ha organic N, the N limit reduces farm profit by between €6,151, and €5,736 each year over the same period. While farms stocked at 210kg/ha organic N, suffer losses of between €3,672 and €3,369 per year from 2007 to 2011 if the organic N limit of 170kg/ha is imposed.

Table 6. Annual Farm profit (2007 to 2011) when an organic N limit of 170kg/ha is applied on a field by field basis with a range of initial organic N loadings.

Initial Organic N output (kg N/ha)	2007	2008	2009	2010	2011
250	28,375	27,585	27,541	27,276	26,901
230	30,417	29,593	29,545	29,257	28,850
210	32,896	32,030	31,978	31,663	31,217
170	36,568	35,591	35,526	35,137	34,586

Conclusions and Implications for Dairy Farming

The results of the analysis presented in this paper show that, as in other EU countries, the introduction of a limit on organic nitrogen is likely to have serious implications for dairy farming. The findings are similar to those of Rigby and Young (1996) in the UK and Berensten *et al.* (1992) in Holland, which showed the tighter the nitrogen restriction the more severe the consequences for profit and for the potential to expand milk production. The results here show that if organic N is limited to 170kg/ha, then given current stocking rates approximately a quarter of all dairy farms in Ireland would experience some loss in income due to compliance. Analysis of the MTR has shown that dairy farming is likely to become more consolidated, with fewer farms supplying national milk quotas (Harvey and Colman 2003; Shalloo *et al.* 2004a; Breen *et al.* 2004). These studies have shown that farmers can maximise profit by increasing dairy cow numbers and stocking rates. When allowing for the change that is likely to occur following the MTR, it is found that the effect of a limit on organic N could have more serious consequences on income. Analysis of this dynamic scenario shows that by 2007 almost 80 percent of dairy farmers would experience some reduction in income if they had to comply with a 170kg/ha limit, by 2012 with further restructuring in the sector this number is projected to increase to 88 percent. A relaxing of that organic N limit to 250kg/ha would ease the economic consequences. With an organic N limit of 250kg/ha, it is projected that just 6 percent of farmers would experience a loss in income. The results show that with a 170kg/ha limit in 2007, almost 40 percent of dairy farmers would experience a loss in income of 15 percent or more. During this time period, dairy farmers will already be facing an immense price cost squeeze due to declining dairy intervention prices and increasing costs of production.

The results of the case study presented in this paper show that if the organic N limit is imposed on a whole farm basis the reduction in farm profitability will be dependent on the availability and costs associated with bringing extra land into the dairy system. If the limit on organic N was applied on a field-by-field basis, then the economic cost of compliance was more severe and hugely dependent on whether the dairy farm enterprise was in one block or had a fragmented land base. Just over one third of Irish dairy farms are concentrated on one parcel of land.

Of the 4.4 million ha used for agriculture in Ireland, around 91 percent is under grassland. A very large proportion of Irish grassland is permanent grassland. The quantity of grass seed sold each year is sufficient to sow between 2 and 3 percent of the total agricultural area. There are many advantages associated with permanent grassland from an environment and animal welfare perspective. Benoit and Simon (2004) showed that grassland resulted in lower nitrate N (NO₃-N) leaching losses than arable crop production, particularly maize silage. Grass based systems in Ireland are based on permanent pasture, which continue to take up N from the soil throughout the year. In contrast arable crops, such as maize, are prone to loss via leaching because there is no uptake of residual N from the soil over the winter period. In a cross country comparison carried out by Dillon *et al.* (2005) it was shown

that the proportion of grass in the diet of dairy cows is inversely related to the costs of milk production. As a result of the imposition of a 170kg organic N/ha limit, increasing milk yield per cow through supplementation would be the only way of increasing output from a fixed land base. This would result in a reduction in Ireland's grass based competitive advantage. The income loss reported in this analysis as a result of the Nitrates Directive deals specifically with an organic N limit restriction. It is anticipated that there will also be an income loss due to the increased slurry storage requirements and increases in the length of the closed periods associated with the Nitrates Directive.

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Technical Annex

The FAPRI-Ireland Farm Level Model

Full details of the FAPRI-Ireland farm level model and the scenarios analysed are available from Breen and Hennessy (2003), a brief description of the methodology employed in the model is provided here. The FAPRI-Ireland farm level is based on a multi-period profit maximising linear programming (LP) model. LP operates by maximising or minimising an objective function subject to some specified constraints. Approximately 900 farms are modelled in total and all 400 dairy farms participating in the Irish National Farm Survey (NFS) are analysed. Farm net margin is maximised over the ten year period following decoupling in a block diagonal matrix form subject to the usual physical, financial, technological and policy related constraints. All activities that exist on the farms in the base data year, 2002, are included in the LP choice set as well as all likely activity options. Transfer activities are used in the LP model to link multi-year activities, such as livestock systems. Projections of prices and costs for the decoupling scenario are taken from Binfield et al. (2003). The input-output co-efficients used are those recorded in the base year and are assumed to remain fixed through time despite policy changes, in other words for any given production process only one combination of the factors of production is assumed. Hence the scope of the models is confined to the analysis of resource allocation decisions, enterprise mix and volume of production decisions, participation in policy schemes and the resulting impact of these decisions on income.

In addition to modelling resource allocation and enterprise activity, the decision to exit the dairy enterprise and to sell the milk quota off the farm is also modelled. The estimation of exit from dairying is based on a profitability analysis. Anecdotal evidence suggests that dairy farmers cease milk production mostly for personal reasons, such as retirement and lack of a successor, and sometimes for economic reasons. In the absence of verifiable empirical data on these personal reasons, it is assumed that the propensity to cease milk production is solely dependent on profitability. Historical levels of profitability and the rate of exit from dairying are examined to identify a minimum level of profitability below which exit has occurred historically. Using the LP model the maximum dairy enterprise income that can be generated on each farm in each year is estimated. Producers operating below the minimum level of profitability are projected to exit production.

Milk quota transfer in Ireland is operated through an administered system. All exiting producers are required to sell their quotas into a central restructuring pool at an administratively determined price. Sale of quota from the restructuring scheme is operated on a priority basis, where smaller farmers have a higher priority in accessing additional quota. This centralised milk quota market is simulated. The quota of all exiting producers is assumed to enter the milk quota pool. It is then reallocated to producers with a marginal cost of production less than the marginal revenue but to the smallest producers first, in order to replicate the rules of the milk quota market.

The results of the analysis show that the profitability of milk production is likely to fall considerably as a result of decoupling. It is projected that the

coupled return to milk production could fall by as much as 15 per cent in nominal terms in the eight years following decoupling relative to a continuation of Agenda 2000 policies. Based on the estimates of the returns to milking cows and on the assumptions outlined here, it is projected that dairy farm numbers will decline by 32 percent in the ten year period from 2002 to 2012.

The Moorepark Dairy Systems Model (MDSM)

The Moorepark Dairy Systems Model (MDSM) (Shalloo et al. 2004) is a stochastic budgetary simulation model formulated within a Microsoft Excel spreadsheet. The model integrates animal inventory and valuation, milk supply, feed requirement, land and labour utilisation and economic analysis. Land area was treated as an opportunity cost with additional land rented in when required and leased out when not required for on-farm feeding of animals. Variable costs (fertiliser, contractor charges, medical and veterinarian, AI, silage, reseeded), fixed costs (machinery, maintenance and running costs, farm maintenance, car, telephone, electricity and insurance) and prices (calf, milk and cow) were based on current prices (Teagasc 2004). The feeds offered (grass, grass silage and concentrate) were determined by the MDSM meeting the net energy requirement for milk production, maintenance and live-weight change (Jarrige 1989).

Default parameters values were obtained from the results of experiments carried out at Moorepark over recent years (Dillon et al. 1995). Total labour requirement per year was calculated assuming 1,848h per labour unit per year, at a cost of €22,855.

REFEREED PAPER

EXAMINING THE COMPETITIVENESS OF CEREAL PRODUCTION IN SELECTED EU COUNTRIES

F.S. Thorne

This paper examines the competitiveness of cereal production in selected EU member states. The analysis showed that productivity levels in the UK, Ireland and France were consistently higher than competing countries Denmark, Germany and Italy. In terms of profitability, the opportunity cost of owned resources had a major impact on relative competitiveness. These findings are important in the context of decoupled payments as producers must make production decisions based on full economic costs of production.

Key Words: Competitiveness, Cereal production, Profitability, Competitive performance, Competitive potential.

Introduction

The competitiveness of the European cereals market has been at the forefront of much debate in recent times in the context of impending reforms to the Common Agricultural Policy (CAP), increasing trade liberalisation brought about as a result of World Trade Organisation (WTO) negotiations, and EU enlargement (Newman and Matthews, 2004). Consequently, the objective of this research was to examine the competitiveness of selected EU cereal producing countries for a baseline period, 1996 to 2000, to provide an insight into the ability of these producers to react to the aforementioned influences. The EU countries chosen for comparison were the UK, Denmark, France, Germany, Ireland and Italy. Together these countries accounted for just under 80 per cent of the total cereal production within the EU-15 during the period 1996 – 2000 (Eurostat, 2003).

The data sources used and methodology involved in the computation of the various indicators of competitiveness used in the analysis indices are outlined in the following section. The results of the various indicators of competitiveness are then outlined and the conclusions from the research identified.

Methods

This section of the paper outlines (i) the data sources and (ii) the measures of competitiveness used in the analysis.

Source of Data

The Farm Accountancy Data Network (FADN) was the primary source of data used in this analysis. The aim of the network is to gather accountancy data from farms for the determination of incomes and business analysis of agricultural holdings. The network consists of an annual survey carried out by the Member States of the European Union. Derived from national surveys, the FADN is the only source of micro-economic data that is harmonised, i.e. the bookkeeping principles are the same in all the countries. Currently, the FADN

annual sample includes approximately 80,000 holdings. They represent a population of about 5 million farms in the 25 Member States, which cover approximately 90 per cent of the total utilised agricultural area (UAA) and account for more than 90 per cent of the total agricultural production of the Union. However, during the period of analysis the ten new accession countries were not included in the survey.

The FADN farm classification type used in this analysis was Farm Type 1310 – specialist cereal, oilseed and protein (COP) producers. The FADN classification for COP farms is not as homogeneous as other enterprise systems defined by the Commission, such as specialist dairy (Type 411). Consequently, the heterogeneity of this farm type presents problems in terms of cost allocation due to the different cost intensities and output prices commanded by the different products in this farm type. However, this approach to comparative analysis was defended by Boyle (2002) because *‘a crop by crop analysis is impossible to obtain owing to the paucity of the sample at that level of disaggregation. Moreover, since several different varieties of cereals are produced jointly, such a disaggregated analysis, even if it were feasible, might not be very meaningful’* (p.119). Nevertheless, efforts were made to redefine farm type 1310, whereby the economics of cereal enterprises were analysed in isolation from oilseed and protein producers. This redefinition of the farm type was based on the apportionment of costs to the cereal enterprise in isolation from total farm output; hence the focus of the analysis was on cereal production rather than cereal, oilseed and protein production. The importance of oilseed and protein production tends to be quite different in the countries examined. In France, for example, oilseed and protein production accounted for 25 per cent of cereal, oilseed and protein output combined, from specialist farms, during the period 1996 to 2000. However, this figure compares to a value of 3 per cent in Ireland over the same period. Consequently, efforts were made to examine the relative competitiveness of cereal production on these farms as distinct from the competitiveness of the whole farm, which by definition specialises in cereals, oilseed and protein production.

FADN data itemises costs on a whole farm basis only, and some method of allocating these costs to the specific enterprises analysed in this research had to be attempted. For this purpose, all cost items, apart from owned land, were allocated based on the per cent of market based output from cereals and allocatable direct payments (ensuing from the cereals enterprise) in the total market based output and direct payments of the whole farm. The direct payments allocated to the cereals enterprise were calculated as the cereals area multiplied by the area aid rate per tonne multiplied by the reference yield for each country. In addition to this direct payment, the additional supplement per hectare for durum wheat was calculated for Italy. Over the period 1996-2000, 42 per cent of total cereal area was devoted to durum wheat production in Italy (Eurostat, 2003). Consequently, it was assumed that 42 per cent of the cereal area in Italy over the period was allocated a supplementary durum wheat direct payment (€297 per hectare), which was in turn reflected in the analysis. No other country in the analysis was allocated a durum wheat supplement based on estimates from Eurostat (2003), which indicated that average durum wheat

levels (as a per cent of total cereal production) were relatively low.

Direct payments were initially taken into consideration for allocation purposes because it was considered that cereal producers based production decisions, and the ensuing allocation of inputs, in the baseline period 1996 – 2000, on the full knowledge that production was coupled to the direct payments. However, in order to determine the likely impact of decoupled direct payments on the competitive position of the individual countries, direct payments were excluded for allocation purposes and costs were allocated on the basis of production output alone.

The only exception to the aforementioned allocation basis (in the baseline period and post decoupling) was made for owned land. Following allocation methods outlined by Fingleton (1995), the owned land resource was allocated to the cereal enterprise based on the per cent of cereals in the total UAA of the whole farm.

Other cost allocation methods were identified in the literature, such as the econometric cost estimation methods, based on panel data sets, outlined by Hallam *et al.*, (1999). However, due to data limitations in the construction of the panel data set for individual farms, such methods were not possible to adopt here.

The specific FADN countries used in the analysis for the purpose of comparing EU competitiveness of cereal production was based on production capacity, export volume and import volume of specific countries. The comparative countries used in the analysis were: Ireland, UK, France, Denmark, Germany and Italy. Together these countries accounted for just under 80 per cent of total EU cereal production over the period 1996 to 2000 (Eurostat, 2003).¹ Table 1 below provides an overview of cereal production in each of the countries examined and data on the FADN sample for this category of farms.

Table 1. Cereal Production Statistics in Selected EU Member States and Sample Statistics from the FADN Database

	Denmark	France	Germany	Ireland	Italy	UK
Cereal Area as % of UAA	51%	39%	30%	7%	25%	21%
Cereal Production as a % of EU-15 cereal production	4%	24%	25%	1%	15%	5%
FADN sample size for farm type 1310	307	623	1,394	26	2,097	515
Farms represented by sample	14,368	25,239	71,417	2,108	183,722	23,108
Average size (UAA) of farms in sample	45	110	97	66	15	142

1. The author acknowledges that EU cereal producers are now competing in world cereal markets and competitiveness in the international market is becoming increasingly important. However, the FADN only provides harmonised data for EU member states, hence restricting the analysis to EU producers.

Measurement

All too often research on the topic of competitiveness tends to focus on indicators of competitive performance (i.e. the measurement of indicators of competitiveness of specific firms, sectors or countries) and indicators of competitive potential (i.e. the measurement of sources of competitiveness) are ignored (Harrison and Kennedy, 1997). Consequently, the indicators presented in this research go some way towards identifying the sources of competitiveness in addition to presenting results of competitive performance.

Competitive Performance

All the measures of competitive performance used in this report are based on profitability as the leading indicator. Boyle (2002) in his analysis of the competitiveness of Irish agriculture stated that '*returns and costs matter to competitiveness*' (p.153). Using profitability as an indicator of competitiveness means that both costs and returns are taken into consideration. Three separate measures of cost and return comparisons were used for comparing the competitiveness of cereal production in the selected member states: (i) total costs as a percentage of the value of output (including and excluding direct payments), (ii) margin over total costs per 100kg of production volume,² and (iii) margin over total costs per hectare of cereal production. Measuring costs of production, in terms of output is consistent with traditional production theory, which aims to minimise costs or maximise net revenue per unit output. However, since the introduction of direct payments paid on an area basis, it is arguably more relevant to examine costs of production on an area basis, as land was the most limiting production factor during the period of analysis. This is especially relevant where there are national quota limits on the land classified as 'eligible' for tillage production.

Competitiveness in the market place for commodities, such as cereals, is largely determined by costs of production (Boyle, 2002). However, this is not entirely the case as quality differences, transport costs to the point of purchase and access to direct payments are also important. Therefore, it was considered important to examine the competitiveness of cereal production in terms of total costs of production as a percentage of the value of output. The value of output in this analysis included both production output and direct payments in the form of Area Aid payments per hectare of production. An additional analysis was also carried out which excluded direct payments from output value to determine the ability of producers to compete in the era of decoupled direct payments.

In terms of the computation of the aforementioned indicators, costs were defined in the following way:

- **Cash costs**, which include all specific costs, directly incurred in the production of a given commodity, for example fertiliser, feedstuffs,

2. The production volume of cereals was calculated based on yield of wheat multiplied by the area of total cereals. Data on the yield of individual cereal crops was not available and the yield of wheat was used as the next best alternative.

seeds etc. plus external costs such as wages, rent and interest paid, plus depreciation charges.

- **Economic costs**, which includes all of the cash costs identified above, except interest charges, plus imputed resource costs for family labour, equity capital and owned land.

The calculation of total economic costs for the competing countries was one of the most problematic exercises in this analysis. If long-term competitiveness is to be examined the assumptions regarding the measurement of opportunity costs for family labour, owned land and other non-land capital must be as realistic as possible. Family labour was assigned an opportunity cost equal to the cost of hired labour.³ The hired labour charge was determined from the FADN data. Owned land was assigned an opportunity cost equal to the cost of rented land, which was also determined from the FADN data. This approach follows the methodology adopted by Boyle et al., (1992), Boyle (2002) and Fingleton (1995). For the purpose of valuing non-land assets the approaches considered by Boyle et al., (1992), Boyle (2002) and Fingleton (1995) were considered. Boyle et al., (1992) and Boyle (2002) recommended using a (i) real interest rate which takes into account taxes, subsidies and inflation adjustments and (ii) a depreciation rate. However, Fingleton (1995) recommended using a long-term interest rate, rather than a real interest (derived from the FADN data) as proposed by Boyle, derived by subtracting the price deflator for private consumption from the nominal long-term interest rates for each country for each relevant year. Both of these approaches were considered but were not adopted for the research. Application of a derived real interest rate substantially increased the spread of rates charged on non-land assets between the countries examined. In addition the application of a long-term interest rate was not considered appropriate given the record of real interest rates over the time period 1996-2000. Due to high inflation in this time period, in many of the countries examined, the computed long-term interest rate was negative in some time periods. For this study a nominal interest rate was applied for each of the countries for each relevant year. This approach was considered to provide more realistic opportunity costs for the purpose of valuing non-land assets in this analysis, than the two methods identified above.

Competitive Potential

The aforementioned indicators of profitability provide an insight into the competitive performance of the countries examined, however, they do not provide an insight into the sources of competitive advantage or disadvantage. Therefore, the individual cost variables (both cash and economic) and associated returns (including and excluding direct payments) were examined in detail, which provides an insight into the sources of competitive potential

3. The determination of an appropriate opportunity cost for own family labour is always an issue in studies which examine costs of production on family farms. The use of the average agricultural wage to value owned family labour may in some instances over value (due to under employment) or under value (due to managerial or entrepreneurial ability) this resource. However, without any further evidence to suggest in which cases such situations arise the average agricultural wage is used in the absence of this additional information.

associated with the competitive performance of the individual countries. Furthermore, as competitive potential 'is concerned with the availability, quantity and quality of inputs and how they are formulated to produce superior performance' (Pitts and Lagnevik, 1998), the partial productivity indicators presented for each of the commodities are also considered indicators of competitive potential. The indicators of partial productivity used in the determination of productivity of selected resources for cereal production were (i) wheat yield – 100kgs per hectare of wheat area;⁴ (ii) land productivity – output from cereal production plus allocated direct payments per hectare of land devoted to cereals; and (iii) labour productivity – output from cereal production plus allocated direct payments divided by the total annual work units (AWU) devoted to cereal production.⁵ It is however important to highlight when using partial productivity indicators that the ensuing results may be different to the findings from total factor productivity indicators.

Results

This section of the paper examines the costs and returns associated with the production of cereals in selected EU member states. The results are presented in two sections: (i) comparative costs and returns of production and (ii) partial productivity indicators.

Comparison of costs and returns on EU cereal farms

The first measure of comparative costs of production and returns for cereal farms was costs as a percentage of total cereal production output and allocated direct payments. Figure 1 shows the five-year average cost:output results for the cereals enterprise for each of the selected countries.⁶ The individual cost components for each of the countries is outlined in Appendix I. Figures 1 shows that cereal producers in Italy had the lowest cash costs as a per cent of output and Ireland had the second lowest cash costs, over the period 1996 to 2000. Cash costs in France, Germany and the UK were also quite similar to the Irish position over the period, with cash costs in Denmark considerably higher than the other countries examined.

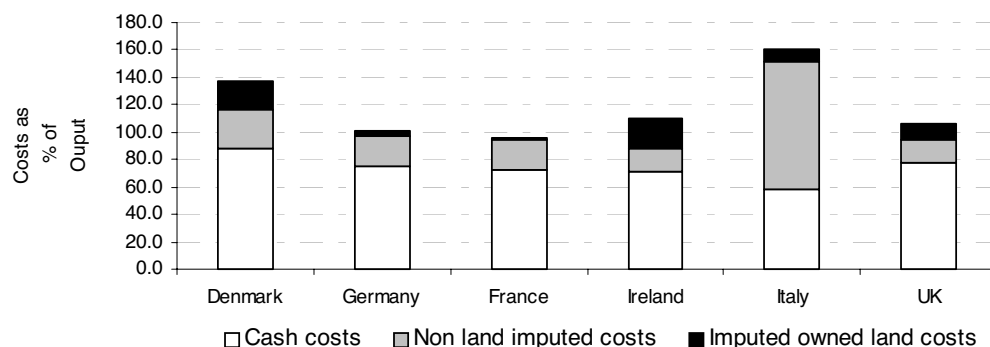
When imputed charges for owned resources were taken into account to compare total economic costs, the ranking between countries changed considerably. Imputed charges were substantially higher in Italy than all other countries, which resulted in Italy having the highest total economic costs as a per cent of output compared to the other countries examined. In particular, as outlined in Appendix I the opportunity cost of family labour in Italy was substantially higher than competing countries and the opportunity cost of owned land was particularly high in Ireland and Denmark over the period. On the other hand, imputed charges for owned resources were considerably less in France than all other countries, which contributed to French producers having

4. Due to data limitations this was the only indicator of cereal yield available.

5. Exchange rates from the FADN database were used for each country and for each year of the analysis. Hence, exchange rates were variable across countries and between years.

6. An average figure over this time period was used instead of selecting individual years for analysis because of the concern regarding atypical years. However, further analysis was carried out between the individual years to determine the stability of the competitiveness indicators over time. No significant shift in the relative competitiveness of the individual countries was apparent.

Figure 1. Costs as a % of Output (incl. market based output plus direct payments) on selected EU Cereal Farms.



the lowest total economic costs as a per cent of output for all countries examined. The specific imputed charges for owned labour and land were significantly variable between countries, which had the effect of altering the longer term competitive outlook for these countries.

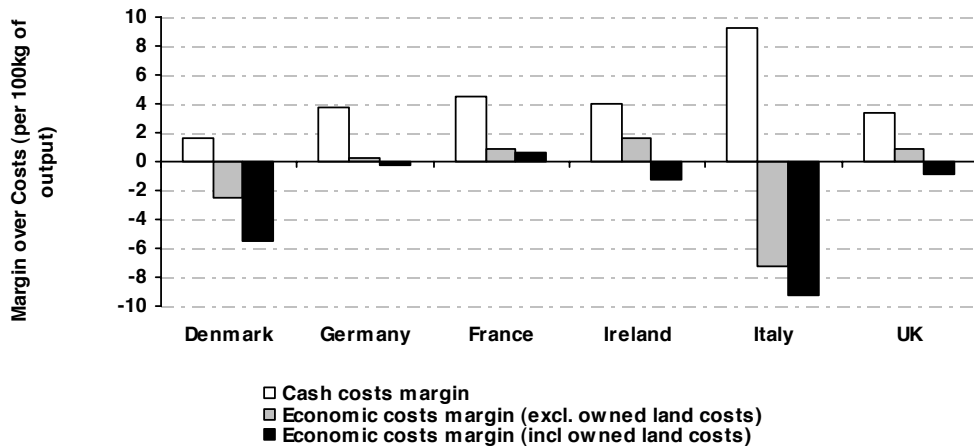
These results are consistent with the findings obtained in Boyle (2002). As the findings obtained by Boyle were based on costs as a percentage of market based output for the year 1999, it was considered important to replicate this analysis for the years 1996 to 2000. This market based assessment is particularly important in the context of decoupled payments given that both market based margins per hectare and direct payments were variable between countries in the baseline period and will continue to be variable in the era of decoupled payments. Direct payments differed between countries in the period 1996 – 2000 due to differences in the reference yields, established by Commission Regulation, No. 2316 (1999). Consequently, to determine the effect of the introduction of decoupled direct payments in January 2005,⁷ costs as a percentage of market based output were examined. This analysis did not show any substantial deviation from the results presented in Figure 1 above. However, the relative position of Irish producers in particular, did deteriorate slightly relative to the average, and France replaced Ireland as the second lowest cash cost producer. This change in competitive positioning may be attributed to the high reference yields established in Ireland in the era of coupled direct payments.

The second measure of cost competitiveness employed in the analysis was margin over costs per 100kg of product volume. Figure 2 shows the average of these results for the period for all countries examined. Appendix II outlines the cost items and revenue per 100kg of product volume for each of the countries.

Similar results are evident in Figure 2 as were seen in Figure 1. The ranking between countries changed when margin over cash costs for the different countries was compared to the margin over total economic costs. The 'best' ranking position for margin over cash costs per 100kgs of cereal output

7. In this analysis costs were allocated to the cereal enterprise based on the allocation key: cereals output divided by total production output. This differs from previous measures of cost competitiveness in that direct payments are not taken into account.

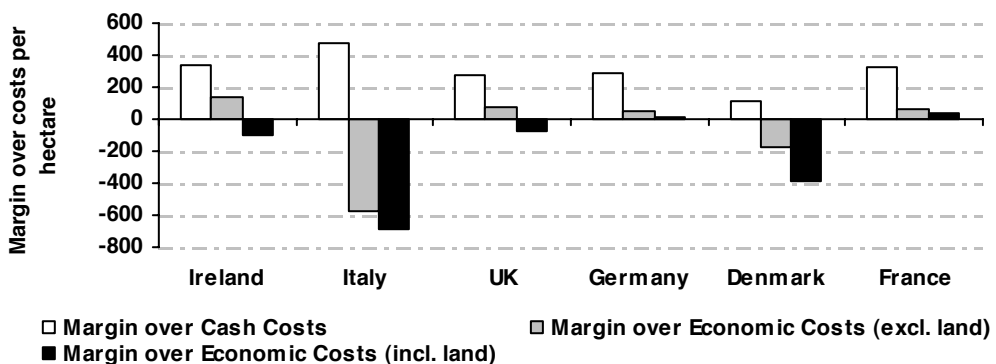
Figure 2. Cash and Imputed Charges for Selected EU Cereal Producers per Hectare (1996-2000).



over the period was witnessed in Italy, and the lowest ranking was in Denmark, with the margins in France, Ireland, Germany and the UK quite similar. However, when imputed charges were considered, to measure the margin over total economic costs, Italy moved into the lowest ranking position with France in the highest ranked position.

The third measure of cost competitiveness for cereals used in the analysis was cash and economic costs per hectare of cereal production. Figure 3 shows the average of these results for the period for all countries examined. Appendix III outlines the cost, revenue and margin per hectare for each of the countries. Figure 3 shows results similar to those in Figures 1 and 2. The margin over cash costs per hectare was highest in Italy, followed by Ireland, France, Germany the UK and Denmark. However, Italy again had the lowest margin over total economic costs, followed by Denmark and Ireland had the third lowest margin, with France and Germany the only countries that managed to retain a positive margin over total economic costs. Furthermore, the results presented here show that imputed charges for owned land have a large influence on relative competitiveness. When these imputed land charges

Figure 3. Cash and Imputed Charges for Selected Cereal Producers in the EU (1996-2000).



are excluded from the analysis, Irish cereal producers again appear to have the highest margin per hectare during the period.

In addition to the specific imputed charges which had a significant influence on the relative competitiveness of cereal production, Appendices I, II and III show the individual cost items and returns associated with the three measures of competitiveness. Analysis of these variables show the prominent *sources* of competitive advantage and disadvantage associated with cereal production in the selected EU countries. This data shows that despite the relatively low cash cost structure as a per cent of total output, and relatively high margin over cash costs evident in Italy over the period, the magnitude of specific direct costs and fixed costs per product volume was considerably higher than competing countries. For example, the cost of seeds and plants, depreciation, buildings, machinery and family labour were all higher in Italy than the other countries examined. However, total revenue per product volume was also higher than competing countries, probably associated with high levels of durum wheat production, which compensated for the relatively high cash costs. This finding highlights the importance of including cost and return variables in the analysis of competitiveness.

Other variables of particular interest in this specific and overhead costs analysis were evident for Ireland, France and Denmark. In Ireland, relatively low machinery costs, other direct inputs, depreciation and paid wages were evident. Low depreciation and machinery charges in Ireland were probably a reflection of the extensive use of contractors' services in Irish cereal production. Kelly and Shanahan (2001) noted that *'this reduces depreciation and allows the capture of the economies of scale associated with the use of high capacity machinery when this is used for long periods'* (p.5). In France, the opportunity cost of owned land was substantially lower than other countries. This finding is probably associated with the relatively high level of leased land on cereal farms in France (Boyle, 2002).

In contrast to these specific cost items, which were relatively low in Ireland and France, there were also a number of items that were higher than other countries, namely, fertilisers and crop protection materials. In Ireland in particular, this could be associated with high usage levels or the relatively high costs of these items in Ireland. Disease pressure on Irish cereal farms does tend to be higher than in the UK or mainland Europe, thus this could contribute to the high cost associated with crop protection materials. The high cost of fertiliser was also evident in other enterprises in Ireland (Thorne, 2004).

In Denmark, comparatively high interest charges were evident. These charges can probably be attributed to the Danish method of farm transfer, *'which is by sales and purchase using a mortgage rather than by gift between relatives'* (Kelly and Shanahan, 2001, p.3). Relatively high depreciation charges were evident in Italy, which were about 40 per cent higher than the average for all countries in the analysis, was also noticed by Kelly and Shanahan (2001), who said that in comparison to other countries examined, these producers tend to be less specialised and much smaller in size. Therefore, it could be said that the depreciation charges associated with cereal production in Italy were associated with a relatively small production area,

thus the depreciation charges per hectare tend to be higher.

The aforementioned individual cost and return variables assist in identifying the relative strengths and weaknesses of cereal production across the EU countries examined.

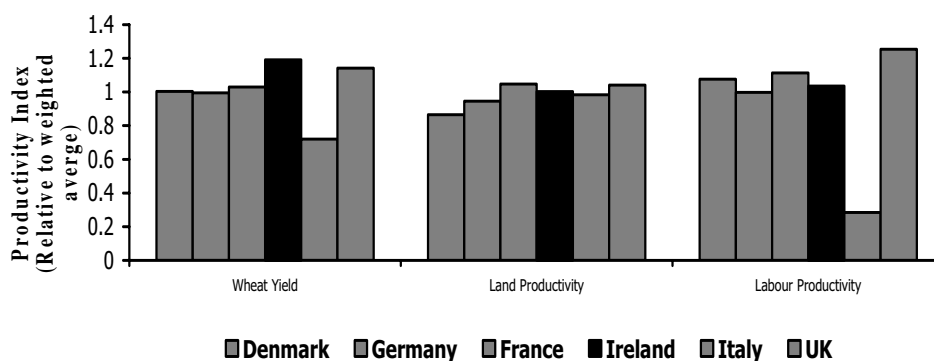
Comparison of partial productivity indicators on EU cereal farms

Figure 4 below shows the partial productivity indicators for the EU cereal farms identified above. The results presented here for each of the countries is the average for the years 1996 to 2000 and indexed relative to the weighted average of all countries.⁸ Figure 4 indicates that Ireland's wheat yield⁹ was the highest over the period, among the countries examined.

Yields in the UK were also relatively high compared to the other countries, with yields in Italy substantially lower than all countries. However, it is important to highlight that substantial volumes of durum wheat is produced in Italy, which attracts higher levels of direct payments relative to other cereal types, which in terms of profitability partially compensates for reduced yields.

Relative differences in land productivity were not as variable as yield. Output per hectare of cereal production was highest in France, closely followed by the UK, with Ireland in third position, followed by Italy, Germany and Denmark. Labour productivity levels, like yield, were also quite variable between the countries examined. The UK had the highest level of output per AWU allocated to the cereal enterprise, with 25 per cent higher output per unit than the weighted average of all countries examined over the same period. All the other countries in the analysis, apart from Italy, were within 11 percentage points above or below the average, but Italy had substantially lower output per unit labour input with levels over 70 per cent lower than the average.

Figure 4. Partial Productivity Measures for EU Cereal Farms (the unit specifications for the indicators outlined in this figure are presented in the methods section).



8. Based on a trend regression analysis there was no apparent significant trend over time in relation to the partial productivity indicators for the EU cereal farms examined.

9. It was not possible to standardise wheat yield for moisture content.

These productivity measures indicate that productivity levels on Irish, French and UK cereal farms were on average more positive than the results shown for the other countries examined. These results are consistent with findings from Boyle (2002) where partial productivity indicators for Ireland, the UK and France were higher than other countries examined.

Discussion and Conclusions

In summary, it appears that for the period 1996 to 2000, the opportunity cost of owned resources had a large influence on the competitive position of the selected countries. Italy appeared to have the lowest cash cost structure but the highest cost structure when total economic costs were considered. France replaced Italy as the lowest cost producer when total economic costs were considered, due mainly to the relatively large opportunity cost associated with family labour in Italy. Furthermore, the high opportunity cost of owned land had a significant influence on the relative competitiveness of Irish producers. The relative importance of the opportunity cost of owned resources will become particularly important in the medium term as EU producers are faced with decoupled direct payments. Full and partial decoupling of direct payments will force producers to make production decisions based on full economic costs of production, including adequate remuneration of owned resources. In the longer term adjustment within the sectors will be a reality which will be dependent on relative resource use and in this situation relative resource costs are needed to understand and analyse the adjustment process. As relative economic costs are considered as a guide to the longer-term competitive position of competing countries, these findings could be considered as warning signals for the future competitive performance of Irish and Italian producers in particular.

In terms of understanding the sources of competitiveness outlined in this research, the deterioration of specific countries' relative position as the unit of measurement changed from cash costs to total economic costs has been demonstrated. A number of factors are important in explaining this deterioration. Boyle (2002) concluded that part of this explanation relates to '*the relatively low scale of primary agricultural activity*' (p.177). In this particular study the examination of scale economics was not possible due to data availability. The extent of the problem for smaller scale farms will become particularly evident when direct payments are decoupled from production and individual farms will need to base decisions on full economic costs of production including adequate remuneration of owned resources. Consequently, the impact of scale of operation on the future competitiveness of EU cereal production, and in particular the ability of smaller scale producers, such as Italy, to survive is considered important in the context of future work in this area.

Furthermore, in terms of competitive potential, the indicators of productivity included in this research are partial indicators of productivity. Further work on this topic should investigate the feasibility of computing indicators of total factor productivity for EU cereal production, given that partial productivity indicators do not tell the entire story and in some cases may be misleading. In addition, the trend over time in relation to total factor

productivity will become an interesting area of research post decoupling given that decoupled direct payments are not index linked. Thirtle *et al.*, (2004) is a good example of the merits of total factor productivity analysis, whereby the decline in UK agricultural productivity was shown to decline over time, through the use of a Tornqvist-Theil index. Other total factor productivity methods should also be investigated such as Data Envelopment Analysis, as outlined by Forsund and Sarafoglou (2002) and Stochastic Frontier Analysis, as outlined by Kumbhakar and Lovell (2000).

In summary, the results of this study provide a baseline position against which the change in competitiveness of EU cereal production can be measured. This is an important development in the process of monitoring the position of EU agriculture. EU enlargement, trade liberalisation in the context of WTO negotiations and impending reform of the CAP will all have major influences on the competitive position of EU agriculture, which can be monitored against the baseline position outlined by this research. In addition, possible areas of future work have been identified.

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Biographical notes

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Appendix I. - Costs as a % of Output for Selected EU Cereal Farms

	Ireland	Italy	UK	Germany	Denmark	France
Total Inputs						
Intermediate Consumption						
Specific Costs						
Seeds and Plants	4.8	5.5	4.3	3.5	3.7	5.3
Fertilizers	9.9	6.6	7.8	6.7	6.8	9.6
Crop Protection	10.4	3.0	9.0	6.8	4.3	9.3
Other Crop Specific	1.2	0.7	1.8	0.7	1.1	0.2
Farming Overheads						
Machinery and Building current costs	6.1	3.4	7.8	7.4	12.3	5.3
Energy	2.6	5.4	3.8	5.3	2.6	3.5
Contract Work	10.3	4.8	4.1	3.5	4.6	3.9
Other direct inputs	2.5	3.4	6.6	7.5	5.3	7.0
Depreciation	5.4	19.5	14.2	14.7	13.5	15.2
External Factors						
Wages Paid	2.6	1.9	8.8	6.5	4.6	2.4
Rent Paid	12.3	3.5	5.6	8.7	4.8	7.3
Interest paid (less subsidies)	2.9	0.6	3.9	2.3	20.7	3.3
IMPUTED COSTS						
Fixed Assets						
Buildings	0.7	6.2	0.5	2.0	16.1	0.7
Machinery	1.9	6.2	3.5	2.7	3.1	2.6
Working Capital						
Agri. Product Stocks	0.1	0.6	1.0	0.1	0.9	0.9
Other Circulating capital	1.8	8.4	2.8	1.9	2.5	2.4
Family Labour	15.3	72.8	12.9	17.6	26.0	18.9
Owned Land	21.6	9.2	12.2	3.6	21.4	1.7
Total Economic Cost (incl. imputed owned land cost)	109.5	161.0	106.5	99.0	133.5	96.2
Total Economic Cost (excl. imputed owned land cost)	87.9	151.8	94.3	95.4	112.1	94.5
Total Cash Costs	71.0	58.2	77.6	73.6	84.2	72.4

Appendix II - Costs (€) per 100kg of Product Volume for Selected EU Cereals Farms

	Ireland	Italy	UK	Germany	Denmark	France
Total Revenue	13.59	22.12	14.72	15.25	13.95	16.50
Total Inputs						
Specific Costs						
Seeds and Plants	0.65	1.21	0.63	0.55	0.54	0.87
Fertilizers	1.35	1.46	1.15	1.05	0.99	1.60
Crop Protection	1.41	0.66	1.32	1.07	0.63	1.53
Other Crop Specific	0.17	0.15	0.27	0.11	0.16	0.04
Farming Overheads						
Machinery and Building current costs	0.83	0.76	1.14	1.16	1.80	0.88
Energy	0.36	1.19	0.55	0.82	0.37	0.58
Contract Work	1.39	1.06	0.61	0.55	0.67	0.64
Other direct inputs	0.34	0.75	0.96	1.17	0.78	1.15
Depreciation	0.73	4.30	2.08	2.30	1.96	2.52
External Factors						
Wages Paid	0.35	0.42	1.28	1.02	0.67	0.39
Rent Paid	1.66	0.77	0.81	1.36	0.71	1.21
Interest paid (less subsidies)	0.39	0.13	0.57	0.36	3.02	0.55
IMPUTED COSTS						
Fixed Assets						
Buildings	0.10	1.39	0.08	0.31	2.36	0.12
Machinery	0.26	1.38	0.52	0.43	0.46	0.43
Working Capital						
Agri. Product Stocks	0.01	0.13	0.14	0.01	0.13	0.16
Other Circulating capital	0.24	1.83	0.41	0.29	0.36	0.39
Family Labour	2.07	16.03	1.89	2.76	3.80	3.12
Owned Land	2.96	2.02	1.78	0.56	3.12	0.29
Total Economic Cost (incl. imputed owned land cost)	14.87	31.34	15.63	15.52	19.52	15.90
Total Economic Cost (excl. imputed owned land cost)	11.91	29.32	13.85	14.96	16.4	15.61
Total Cash Costs	9.62	12.86	11.38	11.53	12.31	11.95

Appendix III - Costs, Revenue and Margin (€) per Hectare for Selected EU Cereal Farms.

	Ireland	Italy	UK	Germany	Denmark	France
Total Revenue	1143	1122	1187	1078	987	1195
Specific Costs						
Seeds and Plants	55	62	51	37	38	63
Fertilizers	113	74	92	72	70	115
Crop Protection	118	33	107	73	45	111
Other Crop Specific	14	8	22	8	11	3
Farming Overheads						
Machinery and Building current	69	39	92	80	127	63
Energy	31	61	45	56	26	42
Contract Work	116	54	49	37	47	46
Other direct inputs	28	38	78	80	55	84
Depreciation	62	218	167	158	139	182
External Factors						
Wages Paid	30	21	103	70	47	28
Rent Paid	139	39	66	93	50	88
Interest paid (less subsidies)	33	6	46	25	214	40
IMPUTED COSTS						
Fixed Assets						
Buildings	8	70	6	21	167	9
Machinery	22	70	41	30	32	31
Working Capital						
Agri. Product Stocks	1	6	11	1	10	11
Other Circulating capital	20	95	33	20	26	28
Family Labour	175	815	153	192	269	226
Owned Land	248	103	143	39	221	21
Total Economic Cost. (incl. Imputed owned land cost)	1249	1806	1259	1068	1380	1153
Total Economic Cost (excl. Imputed owned land cost)	1001	1703	1116	1029	1159	1132
Total Cash Costs	808	653	917	789	870	866
Margin over Economic Costs (incl. land cost)	-106	-684	-72	10	-393	42
Margin over Economic Costs (excl. land cost)	142	-581	71	49	-172	63
Margin over Cash Costs	335	469	270	288	117	329

REFEREED PAPER

FARM OWNERSHIP AND MANAGEMENT IN RUSSIA: A STUDY OF THE NOVOSIBIRSK REGION

J.R. Franks, Zemfira I. Kalugina, Olga Fadeeva and Irina Davydova.

Results from a relatively small number of interviews with farmers, village based Municipal Officers and Rural Development Officers from Suzun Rayon, Novosibirsk oblast are presented. Private farmers were found to be more flexible, innovative and integrated into the food chain than Large Scale (co-operative) Enterprises (LSE) whilst LSE managers prioritise the survival of the village with which it is historically linked. However, recent changes in eligibility for debt relief are likely to make LSE managers more profit focused if they wish to safeguard the village. This will mean switching from production to market orientated co-operatives and a reduction in the workforce. How the local authorities cope with the social consequences of higher rural unemployment will be a key determinant of the success of Russia's agrarian reforms.

Key words: Farming, management, food production, reforms, land use, privatisation, Russia.

Introduction

Collective farming has been the dominant form of farm organisation in Russia since 1929 but the market reforms of the 1980s were followed in the early 1990s by the privatisation of land and the possibility that workers could withdraw their share of the co-operative farm's land and other assets and farm these themselves as private farmers. Workers were faced with decisions which would have lasting importance; should they set up on their own as private farmers or continue as co-owners of the village based co-operative farm.

As expected, these changes have attracted considerable interest from the academic community, any analytical papers have examined the relative efficiency of different farm business forms and organisational types, for example in Eastern European Countries (Davidova et al., (2003); Gorton and Davidova (2003)). Studies into the relative farm efficiency for Russia agriculture include Voigt and Uvarovsky (2001), Schulze et al., (2001), Sedik et al. (1999) and Duncan and Ruetschle (2001); those into the structure and organisation include Deninger (1993), Lerman et al. (2002) and Lerman (2001). Many of these papers concluded that the large co-operative farms so characteristic of Soviet farming are inefficient because they are just too large. For example, Lerman et al. (2002) state, "large-scale collective and state farms – the backbone of socialist agriculture – were inherently inefficient" (p. 85). Hanstad (1998) states that "most studies examining the relationship between farm size and productivity show that the relationship is inverse, that is smaller farms are generally more productive than larger farms" (p. 5). Others authors, such as Deininger (1993), suggests that the Large Scale Enterprises (LSE) should reinvent themselves by changing from production orientated to market orientated co-operatives.

The theoretical underpinning to LSE suffer from diseconomies of scale is presented in Allen and Lueck (1998) as being the result of the trade-off

between moral hazard and gains from specialisation. Moral hazard arises when a worker receives a wage regardless of the effort put in. The possibility of “slacking” or “skiving” makes hired labour especially costly to monitor. Farm managers also need to retain control over each successive stage in the production process. Weather influences cause timing problems between stages of production that favours a multi-skilled labour force that is more flexible in the jobs it is prepared to tackle and in the hours it is prepared to work - production stages in farming tend to be short, infrequent and require few distinct tasks, thus further limiting the benefits of specialisation. In addition to the lower transaction costs of family members vis-à-vis hired labour, Schmitt (1991) explains the success of the family farm structure in Western agriculture by the high degree of organisational unity, common values and shared objectives - which often include the longevity of the farming business.

In addition to establishing common and shared objectives, managerial capacity is often cited as key to farm performance and efficiency (Nuthall, 2001; Rouger et al., 1998). Whilst variables such as age, experience and training are generally presented to explain variation in profitability and efficiency, key aspects of the decision-making process - letting and hiring; buying and selling; lending and borrowing; planning and allocation - which would be expected to influence performance and efficiency are rarely included as explanatory variables. We focused our research onto those key management tasks.

This paper presents case studies collected from structured interviews with the managers of eight farms designed to reveal the relationship between managerial philosophies and business ownership. This is a small number of interviews which we cannot be sure are representative of Novosibirsk oblast, let alone Russia itself. However, they offer an insight into the attitudes, pressures, priorities and operational conditions currently prevailing. Oblasts in Russia have been separated into interventionist and *lazier-faire*: Novosibirsk is an example of the first, and the administration takes a direct interest in the activities of its farming sector. Section 2 sets the scene by presenting a brief history to the farm business forms currently found in Russia. Section 3 presents evidence on the diverging attitudes to farm management practices drawn from interviews with farmers in Suzun rayon, Novosibirsk Oblast, Russia. Section 4 discusses some of the implications of these findings for the rural economy. Section 5 concludes the paper.

Farm Structures in Russia

After 1929 and up to 1992, two types of collective farms were the cornerstone of Russian agriculture, the *kolkhoz* and the *sovkhoz*.¹ Initially they had different management structures and systems for incentivising and rewarding their workers. *Kolkhozes* were managed by an elected chairman and management committee, they were accountable to the farm's members but were bound to obey instructions from local state and party organs on matters of agricultural production and on procurement (compulsory deliveries to the State). Procurements were purchased at prices fixed by the State (the procurement prices) which were low, surplus produce could be sold. The

1. The terms *kolkhoz* and *sovkhoz* were first used in 1918 and 1920 respectively.

residual after deduction for taxes, insurance, capital fund, administration expenses and production costs funded workers' salaries. The amount paid to an individual kolkhoz member depended on the number of work-day units recorded by that individual and the value of each work-day unit (Nove, 1992: p. 244). Each kolkhoz household was entitled to a private² plot of land of, on average, between a quarter and a half a hectare - so called *lichnoe podsobnoe khoziastvo* or LPH (Nove, 1992: p. 245), with livestock generally pastured on common land. The plots and livestock were extremely important for the livelihood of kolkhoz members and a typical household could earn more than twice as much from the sale of their products on local markets than from their kolkhoz wages so the LPH was the prime source of the household's food other than grain.

Sovkhozes (or state farms) were introduced by Decree in February 1919, but few were established until the 1960s. The sovkhaz collective was intended to be a higher form of co-operative than the kolkhoz, but they were essentially state enterprises; sovkhaz employees worked for a guaranteed weekly wage and were entitled to state social security in the same way that industrial workers were. Sovkhozes were given privileged access to credits and other resources, however they remained inefficient, having on average higher costs and lower production than kolkhozes (Nove, 1992). Table 1 summarises the key differences between kolkhoz and sovkhaz before the 1950s.

Table 1. Summary of the key legal differences between kolkhozes and sovkhozes.

	Kolkhoz	Sovkhaz
Status	Cooperative	State enterprise
Management	Elected (in theory)	Nominated
Payment to labour	Before the 1960s: residual after all costs paid, usually lower than in sovkhaz; e.g. work-day unit in 1951-1.40, in 1957 - 4 roubles After the 1960s monthly payment in advance	Guaranteed monthly wage and social security Ex. in 1958 wage 531 rouble/month
Private plots	Entitled	More restricted entitlement
Regulation	Compulsory state deliveries; Instructions from the state/party organs; After the mid 1960s budget constraints softened (accumulated debt, subsidies, especially to meat and dairy farms due to the prices policy)	Plan targets; Instructions from the state/party organs; Soft budget constraints (losses were covered from the state budget)

2. Nove uses the term private, Wengren (1998) uses the term personal. We prefer to use the term private because LPHs are the forerunners of today's household plots, which although not in the commercial private sector are clearly in the private sector.

Both kolkhozes and sovkhozes had extremely limited scope of economic autonomy so there were no significant differences between them in this respect. The differences concerned the relatively privileged status of sovkhozes and were most profound until the 1960s. As a result of deliberate State policies, the working conditions, access to financial resources, investments and rewards for the produce on kolkhozes and sovkhozes began to converge after 1953. Research conducted in the 1970s showed no significant differences between members of kolkhozes and sovkhozes (Arutiunian, 1976; Pockney, 1994); by 1991 Wegren (1998; p 25) reports that the average kolkhoz worker's wage was 87% of the average sovkhoz worker's wage.

After several rather unsuccessful attempts under Gorbachev to increase efficiency of collective farms through reforms aimed at increasing their economic autonomy, the resolution "On the Procedure for the Reorganization of Collective and State Farms" which was adopted on December 29th 1991 allowed for the privatisation of collective enterprises and farmland (Wegren, 1996: p. 152; Kalugina, 1995). All collective farms were required to register by early 1992 and local "Commissioners on Land Privatisation" were created in every sovkhoz and kolkhoz to oversee farm reorganisation. Every farm member had an opportunity to leave the collective farm with their entitlement to its assets, in the form of a land- and a property-share. However, if they decided to remain as members of the farm collective, their land- and property-shares transferred to the farm and became general farm property – if a member subsequently chose to leave he or she would be compensated in money but not receive their initial allocation of land- and property-share. The majority of farms chose to become JSCs, which composed 47% of a renewed collective sector – these are reported in the official Russian statistics under the name of agricultural enterprises (*sel'skokhoziaistvennye predpriatia*) (called here Large-Scale Enterprises (LSE)).³ The defining characteristics of the JSC are presented in Table 2. These farms are managed by a Director who is directly elected by property-share holders. The Director is supported by a management committee of typically between 10 and 15 people, all of whom are appointed by the Director. In many cases the elected Director was the Manager of the former collective farm.

Some of the immediate effects of the 1991 edict were delayed by a 10 year moratorium on land sales that was announced in 1992. Although very little land changed hands, land was no longer technically the property of the State. But the moratorium has caused a decade of intensive political struggle and legal uncertainty concerning land ownership (Skyner, 2001; Kozlov, 2001; p. 35-36; Kalugina, 2001: p. 8-10) despite an edict by President Yeltsin in 1996 which expanded the rights of land-share owners and which helped them secure land when they withdrew from the JSC.

Despite these difficulties, a population of private farmers (*krestianskoe/fermerskoe khoziastvo*) did emerge.⁴ It consisted of individuals who

3. The collective sector also included a small number of farms that retained their kolkhoz and sovkhoz status and farms owned by the Municipal authorities and other types of co-operatives.

4. The number of registered private farmers across Russia peaked in 1996 at 280,100 (Russian Statistical Yearbook 2002: p. 410), but the area of land farmed by private farmers has continued to increase, to 17.6 million ha in 2003 (8.5% of farm land) (Franks *et al.*, 2004).

Table 2. Defining characteristics of agricultural business types: Joint Stock Companies.

Joint Stock Company (Общество с ограниченной ответственностью)	
Membership	Members (individuals or corporations - Участники) contribute capital (e.g. their property and land shares) (вклады) into initial investment (Уставной капитал). Contribution with money and other property is allowed. By the decision of members there could be created reserve fund, etc. All property transferred to the company as a contribution to the initial capital belongs to the company, as well as acquired as a result of the company activities. Land used by the company may be property of the company or of the members who retain ownership to their land. Company can buy land on auction, in this case the size of land shares of the participants may change
Management	Each member has a right of vote on the <u>General Meeting of Members</u> (Общее собрание участников) called at least once a year, number of votes of a member is defined by his share holding. General Meeting elects a Chairman (to conduct meeting), a <u>General Director</u> (representation and management of the company - Генеральный директор) and <u>Management Committee</u> (10-15 members) (Дирекция). General Director is accountable to the General Meeting of Members. General Meeting also elects <u>Revision Committee</u> (Ревизионная комиссия) for control over financial activity of the company
Distribution of profits	Profit which goes to payment of dividends is distributed according to the size of share holding
Liability	Company is not liable for obligations of its members, members are liable for obligations of the Company. All members stand to lose only what they have invested. A member is obliged to compensate to the company losses occurred because of his negligence
Exit	Right of exit without agreement from other members, being paid the value of your share holding. Those who contributed land into initial capital have a right to take land, the location of the plot to be determined by agreement with the General Meeting.

voluntarily withdrew their (and often their extended family's) land- and property-share from the collective farm, or who obtained land from state land funds (fond pereraspredeleniia zemli). The characteristics of the private farms, shown in Table 3, closely resemble the private family farm structure of Western agriculture (in which businesses are mostly family owned and run as sole-proprietorships).

To the surprise of the reformers, in the 1990s household production rather than LSEs or registered, commercial private farms was the largest sector of Russian agriculture as measured by food produced; its share in gross agricultural output increased from 31.8% in 1992 to 53.8% in 2002 (Rossia v tsifrah, 2003: p. 201). About 60% of Russian urban residents have a small area of land which they use to produce food, (Ioffe and Nefedova, 2001(a)) - an even higher proportion of the rural population maintain a household plot or LPH (which are descendants of the Soviet time entitlements of the collective

Table 3. Defining characteristics of agricultural business types: Privately operated farms.

Private farms (6% of land)	
Membership	Typically members of one family. Land and property belong to each family member.
Management	Private farm can rent land, buy property shares, hire workers etc. All decisions are made by the head of the farm who is registered as an individual entrepreneur and who may consult with other family members.
Distribution of profit	Profit is distributed by the head of the farm.
Liability	The head is liable for all his property, members stand to lose only what they have invested.
Exit	Land and property of the farm can be divided only in court, unless an arrangement has been made that the leaving member shall take property proportional to his share. The leaving member cannot take land unless the business is liquidated.

farm members, Caskie, 2000). Production surplus to household needs is sold for cash and this income still forms an important component of the family budget (Fadeeva *et al.*, 2002). Ten years after the Law on Land Reform was passed almost 79% of land was used by LSEs, 8% by private farms, and only 6% by household plots (Rossia v tsifrakh, 2003: p 200), with an average size of only 0.41 ha (Russian Statistical Yearbook 2002: p. 409). But production from household plots represented 92% of potato, 80% of vegetables, 57% of all slaughtered livestock, 51% of total milk production and 28% of egg production (Rossia v tsifrakh, 2003; 202).

Evidence from Farmer Interviews.

The aim of the field work was to investigate how management objectives differed between business ownership types, and to compare the techniques and business practices used to achieve these objectives. To canvas as wide a range of opinions as possible, it was decided to visit eight businesses under different ownership: private farmers, co-operatively owned JSCs, a farm that had been a JSC but which was now owned by the municipal authorities and a farm that had been purchased by “urban” capital.

A case study methodology using structured interviews was appropriate given our prior expectations of the importance of the context within which the business and farming decisions are made (Hussey and Hussey, 1997). Moreover, case studies are particularly valuable in identifying complexities for further investigation. It is this aspect of the case study methodology that made it particularly suited to this research, which although based on a structured interview allowed scope for the interviewee to indicate issues of particular concern. But a potential problem with using case studies is the lack of scope for generalisation (Stake, 1995) and ideally the number of case studies should reflect the degree of similarity between the cases studied (Procter, 1997). However, our sample was constrained by financial resources to being small and by survey design to being highly heterogeneous: therefore the generalised results presented here should be interpreted with this in mind and might best

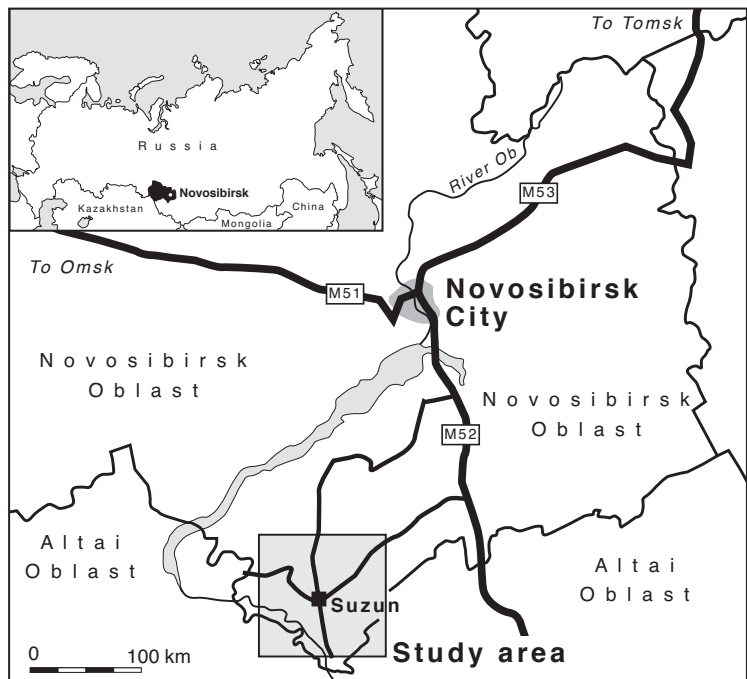
be considered as presenting insights into rather than firm conclusions about the relationship between farm management and farm ownership.

Table 4. Summary of management characteristics

Case code	Business type	Status of head of business	Management structure	No. of restructurings since 1992	Attitude to provision of local social services*	No of changes in main managers since 1992
1	JSC-closed	Director -elected	MC and GA	2	SS	0
2	Private	Self employed	Partnership with one other	1	WS	0
3	JSC-closed	Director - elected	MC, RC and GA	2	SS	0
4	Private	Self employed	Partnership with one other	0	D	0
5	Municipal enterprise	Director - nominated	Employee of the state, MC.	3	VSS	0
6	JSC-closed	Director - appointee	Employee of private farm	>=2	Not able **	3
7	JSC-closed	Director - elected	MC and GA	1	VSS	0
8	Holding company	Director - nominated	Appointed by Holding Company	>=3	D	1

MC = Management committee; RC is revision committee (elected); GA General Assembly (property shareholders). VSS is very strong support, SS is strong support, WS is weak support, D is disregards. Number of restructurings, includes changes of names as well as changes of legal business form. * Ranked by the research team, Directors' responses have not been confirmed from independent sources. ** Had supported village activities and infrastructure in the 1990s when the JSC was profitable, now supports only school and local surgery.

Figure 1. Suzun rayon and the study area.



Suzun rayon in Novosibirsk oblast Western Siberia was chosen as our survey area because of its rurality, its dependency on agriculture, its association with the pre-market reform food processing sector and the availability of the background data needed to select a sample of farms to visit (Figure 1). In particular, data was made available on the legal status and financial performance of each farm. The case studies were chosen after prolonged discussion with the Office of Rural Administration in Suzun rayon. The Rural Administration gave the survey strong support, and allowed us to interview those village-based Municipal Officers who were available (four) and some Rural Development Officers stationed in Suzun; this information supplemented that obtained from the farmer interviews.

Descriptive details of the eight case studies are presented in Table 4. The case studies included two different types of private farm; case 4 is an owner-occupier, a family farmer who was retrenching following a poor year so he had no desire to expand his business; case 2 is a much larger, entrepreneurial business which had grown strongly in the previous ten years and was actively seeking to continue its business expansion. Case 8, a holding company, is an example of the investment of “urban” capital into an agricultural co-operative. This business is located on the edge of Suzun town, and is concerned with pig production and processing, it has never been associated with a village community. The remaining five cases were all JSCs. Two were recognised as successful farms (case 1 and 3); one was under financial stress (case 7); one (case 6) was in the process of being guided by the Suzun rayon administration into a partnership with a private farm (in fact with our case 2 private farm). After several years of poor performance, the Novosibirsk oblast Authority had taken ownership of case 5 in return for settling its debts. All JSCs were managed by a management committee, with an elected farm Director. Our interviews revealed that the Director and the other members of the committees were generally long-serving members of the farm and were often the farm’s Director in the years before 1992 (see Table 4), in nearly every instance the Directors lived in the local village. Their personal skills and experience represented a wide range of specialisations with the notable exception of marketing.

Table 5 shows the farming activities undertaken by the farms. It confirms the large average size of the participating farms whether measured in terms of labour employed or hectares farmed. Compared to Western levels, productivity per labour unit and per hectare was low, average yields of spring wheat were reported as 1.2-1.6 t/ha, 2.5-2.6 t/ha and 3 t/ha, barley typically yielded 2 t/ha. Interestingly, case 2 (private entrepreneurial farmer) believed economic yields of up to 3.5 t/ha should be feasible. There was also a wide variation in milk yield per cow, from 3,400 litres to 4,400 litres (above the Russian Federation average of 2,600 litres/cow).

A major constraint to productivity was the cost rather than the availability of inputs; all the farmers were discouraged by the severe worsening in the terms of trade experienced during 2002 and which had continued through to 2003. Fertiliser prices increased substantially in spring 2003. Grain prices in Novosibirsk oblast fell from RUB 1,853/t in 2001 to RUB 1,347/t in 2002 (*Realizatsia sel'skokhoziastvennoi produkcii* 2003: p. 9 and p. 12) and input

prices had increased, for example petrol prices increased by 10.3%, fodder by 27.5%, agricultural machinery by 8.9% and electricity by 44.7% (Osnovnye itogi 2003: p. 6).

Table 5. Summary of Farm Business Production and Growth

Case code	Size 1992	Size now	Work force 1992	Work force now	Private farmers in the village (initial and current)	Arable	Milk	Livestock (nos.)			VAE
	ha	ha	Full time workers	Full time workers	No.	ha	litres million	Milk	Cattle	pigs	
1	10,800	10,700	400	400	4/4	7,800	5.3	1200	3600	800	4
2	250	4,311	Na	Na	4/4	4,500	0	0	0	0	4
3	12,000	10,500	340	315	100/24	3,900	3.0	866	3000	1200	4
4	140	140	0	10	100/24	140	Na	Some	0	481	8
5	10,441	8000	400	200	10/3	8,000	Na	800	1,200	0	8
6	5,000	2,800	100	50	50/10	2,800	0	0	0	0	8
7	17,000	18,500	420/450	300/350	3/1 (4/2)	5,800	3.3	1,000	1,100	500	4
8	0	0	296	110	Na	0	0	0	0	11,400	4

VAE - value added enterprises, 4 = yes, 8 = no.

The private farmers were more specialised with less emphasis on livestock and more on grain production. They also had a track record of being more reactive to market prices in the crops they grew. For example, case 2 (private entrepreneurial farmer) had been successful at growing crops that had been most in demand, and this was the principle reason given for its rapid expansion. The JSCs grew a wider range of crops because of their need to produce feedstuff for their livestock enterprises which typically consumed about 40% of the grain they produced, and to have the materials available for the “payments in kind” that comprised such an important part of the members remuneration (see below).

Managing labour (letting and hiring).

Given the large size of the farms, the complex cropping structure and the huge labour force, wages and other remuneration are seen as key incentives in the management of the labour force (Allen and Lueck, 1998; Schmitt, 1991; Fadeeva, 2003; Kalugina, 2002). A summary of the wages and dividend income paid to the workers is given in Table 6.

Monthly cash payments varied between farms, with one JSC paying RUB 600 and another RUB 2,060. In addition, employees were paid in kind with grain, fodder and/or piglets. As the Director of a JSC said:

“Wages are very low - the farm is buried under taxes. But we give people fodder so they could produce the maximum possible from their household plots”, (case 1).

Table 6. Wages, payment in kind (PIK) and other earning and resources reported from the survey interviews.

Case code	Wages		Land-share		Property-share	Households		
	RUB/month	PIK	Size (ha)	Payment (per land-share)	Dividends	Number	Livestock	Livestock
1	2,000	25gms/R wage and discount grain price	12.8	1 t grain, 0.5 t hay	Na	451	220	1397
2 *	5000	Na	Na	0.2 t grain / ha and 0.1t hay	Na	Na	Na	Na
3	1,700	Yes, but not disclosed	13	1 t hay and 0.5 t grain	Between 1998 and 2002, not currently	672	288	439
4	Na	Na	Na	Na	Na	Na	None	None
5	1000	To the value of RUB 400/ month	17	No payment but favourable terms	None	708	344	1658
6	Wage pool	None	17	0.4 t grain and 0.3 t of grain wastage	None	708	344	1658
7	2060	Discounted prices for grain etc.	22	Discounted prices	None	431	179	350
8 *	Na	none	Na	Na	Not known	Na	Na	Na

* These are payments made by the firm, and as land is leased from several villages, payments are averaged.
Na = not applicable.

Some workers also received a payment for their land- and property-share used by the farm and there was the possibility of being paid a dividend payment on their shares in good years, though few Directors liked to do this. The JSCs' management structure gives Directors a powerful influence over the level of payment to land- and property-shareholders, and on deciding whether a dividend is paid from the annual profit. One Director was fundamentally unwilling to make any payment to holders of land-shares (not working in the JSC), asking;

"Why should people who do not work on the JSC benefit from the work done on the farm?" (case 7)

An increasing percentage of the work force does not have land- or property-shares. For example, in case 1, 15% of the workforce does not own

land- or property-shares, in case 3 the figure is 30-40%, in case 7, 60% of workforce do not own shares. The Directors also argued that they cannot afford to pay dividend:

“If production was profitable, if there was enough help from government, then yes, we could afford it. Then land-shares would work. There would be rent and dividends paid. But today we only just manage to balance our books. If I pay dividends how will I pay those who work on the farm?” (case 7).

The private farmers and holding company had noticeable different hiring and firing practices. As stated above, case 2 (private entrepreneurial farmer) was discussing a partnership with the failing JSC (case 6) in a deal overseen by the Municipal Authorities. As part of the takeover, the private farmer was prepared to pay unpaid back wages to the JSC’s employees but his quid-pro-quo was to reduce the existing managerial staff by 30% using a wage pool (from which all managerial salaries would be paid, thus all employees could remain if they chose to take a wage cut, but as more left the wage of those remaining would increase).⁵ The private farmer was prepared to give additional allowances to his key staff, for example, he had offered accommodation allowances to four specialist mechanics recruited from the Altai oblast. The JSC managers had also indicated that they tried to solve their employees’ housing problems, their resources were more limited:

“The (case 1) JSC has many problems recruiting specialists, but we do not increase wage - either to workers or to specialists”, (case 1).

Attitudes to absenteeism were also very different. Whereas the JSCs would take back their sacked and absent workers, the case 2 farmer would not under any circumstances. He had very strict rules concerning absenteeism:

“If a worker was absent for a day, he at once loses 500 roubles from his [monthly] wage. We do not go back on this system of fines - despite the possibility that tomorrow this worker may leave and his combine stand idle - in such an event, either I or my partner will take over the combining”.

The pig producing and processing farm owned by a holding company (case 8) had aggressively reduced its work force from 296 to 110 since taking over the business in 2001. Employees were asked to sit formal, oral examinations related to the business, and those who failed to demonstrate sufficient understanding of their role and work within the organisation were dismissed.

The dependency of the rural population on their household plots makes them highly dependent on the payments in kind. These payments bind the farm worker to the JSC, and the JSC to the village. It is a tie that private farmers have broken and as more land is farmed privately, the tie will be further weakened. The JSCs are the largest employer in the villages, so workers dismissed from the farm have either to leave the village or live by their LPH

5. 40 of a total staff of 70 were classified as managerial.

(without the benefits of payment “in kind”). The inter-dependency between rural households, household plots and JSC creates a strong "symbiotic" relationship between the rural farm worker and the collective enterprise. This relationship has some motivational influences on the farm's workforce but also underpins the rural economy and the coherency of the village community (Kopach, 2000: p. 223-262; Fadeeva, 2003: p. 225-231).

Value added enterprises (planning and allocation).

Five of the farms had a value added enterprise (VAE) (Table 7); on four farms the enterprise started after 1992 investing retained profits. The prime motives for these investments were increased profitability but also security of food for the villagers following the dismantling of the food supply chain (see below).

Table 7. Summary of Value Added Enterprises (VAF).

Case study	Type of VAE	VAE established post 1992	Distribution area of VAE	Growth trajectory
1	Flour mill, bakery, pelmeni and pasta, invested in sausage in 2001	Yes	Village only	Increasing product range
2	Flour mill built in 2002.	Yes	Widespread	Increasing volume
3	Bakery (established in 1996), condensed milk	Yes	Mostly local village	Static but plans to invest into sausage
4	-	No VAE	-	-
5	-	No VAE	-	-
6	-	No VAE	-	-
7	Flour mill, Butter, cream, bakery and processed meat and sausage (formerly cheese also), pelmeni.	Yes	3 local villages and 1 in neighbouring rion	Decreasing volume
8	110 varieties of sausages (also sales surplus pork.)	No	Widespread	Increasing volume decreasing range

It is important to note that whilst case 8 produces a large proportion of the pork meat it processes, its processing arm is a key and integral part of the business (it buys in pork to supply its processing plant when necessary). This makes case 8 a special case in this sample.

After establishing a reputation for high quality food, case 7 gradually reduced its VAE until it now serves only its own and three neighbouring villages. Case 1 has recently invested in additional processing capacity, again

with the primary intention of providing low priced staple foods to local villages only. Cases 2 and 8, two of the more commercially orientated businesses, have both expanded their value added enterprises in recent years; both based this decision on commercial grounds as neither is linked to a village. Both marketed their products wholesale for eventual consumption by urban consumers.

The JSC Directors openly acknowledged that their VAE were continued primarily as a service to their villagers, and that these products were subsidised by the farms. For example, bread that would cost RUB 6 in the local town was sold for RUB 3. The Directors recognised that this was a subsidy which amounted to the provision of a "social service", and that this service reduced farm profitability. However, this subsidy supported JSC workers and their families and so supplemented low wages. All the Directors expressed particular concern for the livelihood of the pensioners in the villages (who made up a large part of the JSC's shareholders) and for others on fixed incomes who would suffer increased financial hardship if prices for staples increased.

Marketing (buying and selling).

In 1982 the Soviet authorities launched a Food Programme designed to improve the food supply situation and the poor co-ordination among components of the domestic agri-food system. Agriculture and food processing were forced into a single government agency, named *agropromyshlennyi kompleks* (APK). Rayon level APKs were created, and links within the food chain were fairly rigid, i.e. every collective and state farm received a procurement order specifying the exact amount to deliver to a given processor (Ioffe and Nefedova, 2001(b): p. 394). As a rule, one processing plant existed for each of the procurement zone. Suzun rayon was designated a procurement zone. Following market liberalisation in 1992, these centralised, vertically integrated procurement channels so characteristic of planned economies were completely dismantled. Farmers enjoyed greater contractual freedom as they were no longer linked to a single buyer. But the new trading environment required new skills in sales and marketing. A particularly serious problem from the early 1990s which still persists today was the difficulty establishing the creditworthiness of potential purchasers.

Cash flow shortages, created by debt default,⁶ late payment for delivered produce and low prices, created a "hand to mouth" existence for many farms:

"They (case 6) sold almost all their grain 'for a song' - either to the Food Corporation or to pay for pesticides and spare parts. In short all grain was taken and they were left with nothing." (case 2 commenting on case 6).

The practice of paying for delivered produce a month after delivery was a point of contention for many Directors, though it was regarded as acceptable by case 2.

6. Including debt defaulted by the state. Thus only about a half of grain sold to the state between the 1990-1991 harvests was paid for (Wegren 1998: p.70)

In the 1980s all agricultural produce from Suzun rayon was processed within the rayon (interview with the Deputy of the Head of the Agricultural Department, in the Suzun rayon's Administration). The situation has changed since. All of the Directors and private farmers we interviewed confirmed that they now had a choice of several potential buyers. In 2003 most grain not used by the farm's VAE or to feed livestock was still sold to flour mills located in Suzun. But most meat and milk was sold outside Suzun rayon. Some milk was still sold to the butter making factory in Suzun, but most was sold to Sibirskoe Moloko Company (Siberian Milk) in Novosibirsk City (a company owned by a Moscow based firm). There were at least 5 potential buyers of meat, some were in Suzun but others were in neighbouring oblasts of Altai and Kemerovo.

Prices varied with the quality of produce and quality adjusted price schedules could be compared between potential purchasers. However, the overriding concern of all the farmers and Directors we interviewed was with the financial security of the purchasing firm. There were many complaints about unpaid deliveries and late payments. Companies that were established businesses, or those that could offer cash in advance or secure lines of credit were favoured customers, albeit at a discounted price. Securing stable markets for their produce, especially for milk, was seen as a priority.

The Directors of the private farms case 2 and case 8 were aware of the importance of product quality. The Director of case 2 is currently actively seeking to raise the quality of the grain they produce to improve flour quality which would help to develop a strong brand name. Case 8 had recently revised the diets used to feed its pigs, to both raise efficiency and productivity and also product quality. The company currently produce 111 product lines, to which it could add should market demand change. All produce is sold to wholesalers or large retailers with whom it keeps in close contact. The company also buys pork from household plots, and was happy about the quality of the meat available.

To both of these large private companies, marketing was a key issue, but none of the JSC Management Committees included a specialist marketer (not even those JSC with their own retail outlets). Marketing appeared to represent little more than sales to most JSC Directors. Our interviews revealed no evidence of active integration between the different sectors of the food supply chain, and produced no evidence that farmers or food processors were cultivating partnerships and a co-operative ethos along that chain.

Lending and borrowing

The pre-1992 collective farms were not co-operatives in the sense expressed by Tawney (1922):

“The nature of cooperative businesses is that membership is voluntary, that each member has an equal voice, and that members share the same values and objectives” (Tawney, 1922: p. 277).

Although on paper the post-1992 JSCs do share these characteristics, our survey showed clear contradictions between the theoretical management

model underpinning the co-operative basis of the JSCs and the way the General Assembly elected and influenced the farm Director and the management committee:

- (1) The JSC are by law voluntary associations, however the considerable uncertainty about the legal procedures and workers rights had resulted in a reluctance of some land- and property-shareholders to withdraw their shares from the JSC.
- (2) Each member has an equal voice at the General Assembly, but our survey suggested that the farm Directors exercise considerable influence over the General Assembly.
- (3) There is a clear incentive for workers to maximise the time spent on their own LPH rather than on the JSC (indicating a substantial moral hazard problem).

Data is available on the sources of finance used by farms. Long-term investments are almost totally from own resources, whereas 90% of short-term loans used to finance working capital are borrowed from commercial banks (Sel'skoe khoziastvo v Novosibirskoi oblasti, 2003, p.33).

Discussion

Table 8 shows the similarities and differences in objectives and attitudes between the JSC Directors and the private farmers. The limited number of cases included in this research suggests that these generalisations should be treated more as provisionally findings than clear cut divisions. However, the findings were supported by the interviews with the Local Suzun Authority and the survey was conducted by a team with considerable experience in this field, so we consider them to be robust and worthy of further comment. The key differences in management techniques and methods used by private farmers appear to be:

- a greater willingness to use new techniques to manage, motivate and reduce the workforce.
- more specialisation of production.
- greater flexibility of production.
- different business development aims and strategy.
- different attitudes towards marketing, and
- different attitudes towards supporting local communities and villages.

Both groups of managers wanted to increase labour productivity and both agreed that this could best be achieved by reducing the size of the labour force. However, JSC did not appear to have a strategy to achieve this. Private farmers, on the other hand, used a range of techniques from wage funds, formal testing of employees' skills and knowledge, and dismissal for absenteeism. Private farmers were more proactive and flexible in securing the services of agricultural and mechanical specialists.

All the managers we interviewed were recognisably western in their appraisals of their farm's financial performance. Nevertheless, all the JSC Directors were absolutely determined to hold their farm together in a single, large, trading enterprise, and thus prevent its division into smaller private farms – the strategy that most of the research papers reviewed in the

Table 8. Comparison of management objectives and methods.

Issue	Managers of private farms	Managers of JSC
Farm management structure.		
Voluntary.	8	4
Equal voice in elections.	8	4
Members enjoy shared aims.	8	4
Members can exercise their rights.	na	8
Management accountable to the workforce.	8	8
Business organisation.		
Have good cost management.	4	8
State they would like to reduce their labour force.	4	4
Use wages to incentivise labour force.	4	8
Use payment in kind as incentivise labour force.	8	4
Focus on single crops.	4	8
Change crops regularly.	4	8
Actively trying to increase yield.	4	8
Actively seeking to expand the business.	4	8
Ongoing investments in value added enterprises.	4	8
Actively expanding value added enterprises.	4	8
Access sources of advice.	4	4
Actively involved in marketing.	4	8
Positive attitude towards supporting local communities.	8	4

introduction suggested should be followed for Russian agriculture. This reduced their capacity to manage one of the biggest problems faced by the JSC, that its members did not contribute equally (the moral hazard problem which is a common problem of co-operatives (SAOS, 2003)). The Directors did not have any clear mechanism for coping with the high levels of free-rider behaviour (through absenteeism and higher levels of theft). As a result of these conflicting aims, the JSCs maintained higher levels of employment than needed or which could be managed successfully, and continued to subsidise basic food stuffs and to assist with the provision of infrastructure services (such as hospitals and transport, and take responsibility for repairing local utilities). As a direct result of this the Directors were compromising farm profitability.

On the other hand, the private farmers we spoke to determinedly resisted absorbing most (but perhaps not all) of these “non-productive” social costs. Therefore, if the Authorities allow JSCs to fail they will be left with a serious social welfare problem to finance, but this is precisely what they are planning to do. Farm profitability has been very variable since 1992 and in most years a

majority of JSCs have reported losses (Franks *et al.*, 2004). In response, the Government has introduced several debt restructuring programmes, the most recent being the "Financial Healthification Programme". Managerial expertise is closely linked to financial management and Schulze *et al.* (2001) found that debt was related to legal business form. However, they reported that "the majority of managers surveyed believed that the debt problems can be solved only by the government" (p. 67). Until now, Directors have felt protected from bankruptcy by the expectation that another round of debt restructuring would remove their accumulated debt. The realisation of this expectation removed a key incentive to improve efficiency and profitability, thereby reducing investments from retained profits. But the Financial Healthification Programme appears to be tougher than previous debt relief programmes. Some of the least viable JSCs have been excluded from the programme, effectively allowing them to go bankrupt and in so doing making more land available to private farmers. Our survey studied this process in action, as case 2 (private farmer) was negotiating the take-over of land currently farmed by case 6 (JSC), with the active support of the Suzun rayon Administration. If this policy is pressed, the survival of the village will increasingly be linked to the profitability of the JSC, rather than to the social service functions provided by them.

JSC Directors are insistent that they do not wish to give up their potential advantages of size, notwithstanding the difficulties of managing their large labour force. An alternative is to reinvent themselves as market orientated "service" co-operatives of the type recommended for former Soviet countries by Deininger (1993) and in Britain by Fearne and Bates, (2000). Changing the culture of the co-operative membership away from production orientation will not be easy, and the lack of expertise in marketing represents a major challenge. The JSCs will need to clarify objectives and values and re-engage with developing forward linkages along the food chain. Achieving these objectives is likely to require the re-structuring of the ownership-reward system currently in operation, to shift away from equal to equitable treatment based on a realistic return for the capital each member has invested in the JSC co-operative.

Conclusions

Our small sample illustrated clear differences in the management objectives, attitudes and techniques used by private farmers and JSC Directors. Private farmers have adopted innovative management practices especially with respect to letting and hiring, buying and selling, lending and borrowing, planning and allocation. These attitudes, coupled with their clear reluctance to absorb social costs, give them a clear competitive advantage over the JSCs. It is clear that these differences will have an enormous impact on the relative efficiency and profitability of different organisational types.

The new Debt Healthification Programme will restrict access to debt-relief, thereby allowing farms (of all types) to go bankrupt, freeing resources for the more efficient farms. Our interviews found that the larger more efficient private farm was seeking opportunities to expand. As the new round of debt restructuring links the village's prospects to the profitability of the JSC, the

threat of the removal of debts from the economically weak farms is likely to result in many JSC Directors adopting some of the more progressive production and management techniques used by the private farmers. These changed priorities are bound to lead to an increase in rural unemployment as labour forces are reduced. It is interesting to speculate whether this will increase village food production which is the combined output of the JSC, the private farms and the LPHs. LPH productivity is likely to fall as people leave the village and with a small proportion of those remaining eligible for the payments in kind made to workers, which have traditionally supported production from LPH.

The private farming sector certainly appears able and is willing to farm the land released by collapsed JSCs, but our findings suggest it will not want to employ much of the low skilled labour thus released. What the consequences will be for rural employment and village structure remain unclear. In Russia, JSCs are the cornerstone of agriculture and agriculture is the cornerstone of the rural economy. Partnerships between private farmers and JSCs offer one way to maintain economic activity in the villages, but how the Authorities cope with the social consequences of the transformation of increasing numbers of JSCs to profit driven, market orientated, co-operatively owned, collective farming will be a major determinant of the success of Russian agrarian reforms.

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CONFERENCE PAPER

RECONNECTING CONSUMERS WITH AGRICULTURE

Dame Deirdre Hutton¹

Introduction

Let me begin by first thanking the organisers for inviting me to be the keynote speaker, and say what a great pleasure it is to be here at Reading University, such a renowned centre for agricultural studies.

I was thinking about this event a few weeks ago around "Apple Day". The idea of an Apple Day first surfaced in the 1980's to highlight the rapid loss of orchards in this country as well as the loss of our regional apple heritage. It was given fresh impetus by the charity 'Common Ground' who organised their first event in October 1990 in Covent Garden. In 1991 there were over 50 events up and down the country ranging from those held in markets and village halls to menus in National Trust houses, pruning and grafting classes, apple road shows by horticultural societies and apple food and drink in the Houses of Parliament. And by 2000, Apple Day was celebrated at more than 600 events around the country and abroad. A typical festival includes: apple bobbing, baking competitions, learning about grafting and pruning, taking fruit from own trees to an "apple doctor" for horticultural advice or identification and, a longest peel competition. I'm sure the idea of Apple day, and the parallel with the current difficulties faced by wider British agriculture will not be lost on you.

This story connects me to the title of my remarks - "reconnecting consumers with agriculture". The disconnection theme is quite a common one these days. It is used to explain a general malaise amongst consumers towards most institutions and is probably exemplified best by people's attitudes towards politics and voting. But I think it is possible to make a good case for attributing this malaise to the very real lack of opportunity to engage properly in the processes of civil society. This applies just as much to food as other areas of society and disconnection was of course a central theme of Sir Don Curry's report on the future of farming and food - he actually said that "*farming has become detached from the rest of the economy and the environment.*"

And so, in my speech tonight I would like to talk a little about the organisation I chair - the National Consumer Council (the NCC) - and the way we work and what we consider to be the five key trends which are shaping consumer futures. And I would then like to reconnect into agriculture, and touch on some key drivers for change. The futurist, Andrew Zolli, said that future studies included 'the principled study of the possible, probable, and preferable future of institutions and societies, and the steps required to bring about those futures'. This means it is important, in embarking on this theme of reconnection, first to understand the environment and market in which consumers operate. Consumers do not separate each area of their lives into

1. This paper was presented at the 21st Edith Mary Gayton memorial public lecture at Reading University on the 8th November 2004. We are grateful to the organisers for permission to reproduce it here.

different segments, but will carry over into food and agriculture the experiences they are having elsewhere in their lives.

First the NCC: primarily it is an organisation that advocates change in areas where we believe consumers are not getting a fair deal. It is not about unbridled consumption but about value for the money we pass to providers in exchange for goods and services. NCC is an open and collaborative organisation that is willing to work with public service providers, businesses and regulators in order to push forward our ideas. Our relationship with the Department of Trade and Industry – our main funder – gives us a strong connection within government whilst allowing us to maintain our independence of thought. What makes us unique is that:

- we analyse the drivers lying behind market structures – research that helps us to champion new policies to benefit consumers.
- we work across both the public and private sector.
- we don't just respond to today's concerns, but look ahead to tackle the issues that will drive tomorrow's economy and society.
- we have a special remit to look out for the needs of disadvantaged consumers

I would like to share with you an abridged version of some longer-term research we have been doing into consumer trends.

i) Rising incomes

UK consumers spend £667 billion a year and this consumption helps to fuel a strong economy. Communication, spending abroad and recreation and culture have all risen sharply in terms of consumer expenditure. Some of this is down to credit. Consumers currently repay around £36 billion in interest on mortgage borrowing and around £24 billion in interest on unsecured credit commitments. In 2003, consumer expenditure on food and drink came to £146.2 billion and, whilst the percentage of household expenditure spent on food bought into the home is in decline – it's now about 10% - the poorest households spend about 25% of their expenditure, compared to only 6% for the richest.

ii) Service economy

While the consumer market for manufactured goods is strong, it is the service sector that dominates the UK economy, accounting for 71% of gross value added in 2001. Services have considerable potential for consumer harm, as consumers are less informed as to the worth of what they are likely to get. Concerns around services often revolve around four issues of information:

- not knowing what the quality of a trader will be;
- being locked into contracts and costs;

- not being able to gauge a fair price at the outset;
- being open to mis-selling where the service is complicated and you have to rely on the advice you are given.

iii) Consumer diversity

We live in an increasingly heterogeneous society where consumer concerns and experiences are as diverse as consumers themselves. Diverse consumers mean diverse consumer desires and interests for business to respond to.

EDLP - 'every day low prices' is a strategy used by food retailers, but even for them, the idea that price is all is a myth. With growing disposable income, many consumers prize convenience – valuing products and services in terms of value for time, not simply value for money. Beyond that are green and ethical issues which are difficult to assess because customers' intentions are not always the same as their buying decisions. But what is clear to us is that a growing segment of the population are interested in these issues.

iv) Consumer exclusion

The UK has high rates of relative poverty, particularly in households with children. Women are more likely than men to live in poverty – in particular lone mothers and retired women who live alone. Your chances in life, from health outcomes to career opportunity, are closely related to your social background, even from the earliest stage of childhood.

The cost of living varies too, with average consumer prices in London 15% higher than in the North East. Yet children in London and the South receive the lowest pocket money and children in Scotland the highest!

There are some goods and services that all consumers need to be able to access. These are 'everyday essentials' such as energy for heating the home or nutritious food for the family. Yet research by NCC, our sister councils in Scotland and Wales, and the General Consumer Council for Northern Ireland, demonstrates that poorer and vulnerable consumers all too often pay more, or get less, for these goods and services. For example, nearly two million people cannot afford to heat their homes adequately, resulting in up to 50,000 winter deaths, and a cost of £1 billion to the Health service (NCC Paying more getting less, Sept 2004)

v) Unsustainable consumption

If everybody in the world consumed at the rate that we do in the UK then we would need two more planets! If we carry on consuming the way we are now in the UK, then taking one example – climate change - the principal impacts for consumers may be:

- Threats to coastal communities.
- Higher temperatures, or dramatically lower temperatures.
- Increased and more intense rainfall will bring droughts and flooding

- Costs of mitigation or prevention. The funding for much of the shift out of fossil fuels like oil may ultimately fall to consumers.
- Decline in some unique British wildlife.

Not all issues of sustainable development are getting worse. But by common consent, climate change is. And we cannot now avoid it.

Climate change

Having looked at some key consumer trends, I would like to focus a little longer on climate change, a driver if ever there was one for the push towards more sustainable agricultural practices. And a trend which farmers, more than most, are well aware of. But I believe we are faced with a serious dilemma here: responding to climate change is likely to lead to increased production costs which will ultimately end up in the consumer's supermarket shopping basket. We already know that the poorest in our society spend a larger proportion of their income on food, so the last thing we want to do is advocate policies that might push more consumers into food poverty.

But if the government is serious about tackling climate change and broader environmental degradation then the poor may well end up being hit hardest unless we can find clever ways of balancing the burden. We are already seeing examples of this: e.g. industry lobbying government for a £15 levy on electrical goods as a result of the Waste Electrical Equipment (WEE) Directive. This dilemma is one that we will all need to face up to sooner rather than later.

It's also why I think we need to be clear about what we mean by sustainable production. There are many definitions, but this one will do for now,

"A sustainable agriculture must be economically viable, socially responsible, and ecologically sound. The economic, social, and ecological are interrelated, and all are essential."

Using arable farming as an example, what this means in practice is less energy inputs (including food miles), less pesticide use and therefore pollution/waste, increasing biodiversity, more bio-fuels, etc. Could I also be clear that I do not limit this approach to organic production alone.

However, it's not just consumer trends and climate change that drive the market. There is of course the political dimension, manufacturing and the retail environment. I'm going to talk mainly about the political and retail elements, but clearly these are not mutually exclusive.

Political drivers

It is now some time since the Curry Commission reported – indeed we had the two-years-on conference earlier this year. What we can still say about Curry is that it provided a vision for the future of farming and food which still holds good. Of course it also gave some much-needed direction to the politicians and, I like to think, some hope to farmers.

The changes introduced following the mid-term review of CAP are clearly a big driver for change. The single farm payment is much more than tinkering – it represents a fundamental change from what we’ve had for the last 60 years by decoupling subsidies from production. It means that what the market wants must feature much more highly in farmers’ thinking.

What is abundantly clear is that governments, by their actions, need to send a strong signal to producers and retailers about agricultural practices and the long-term effects on the environment and climate. Such a signal may be fiscal, but it needs to be strong enough to change behaviour. For the time being we have the single farm payment linked to cross-compliance requirements, additional payments for entry level schemes (flat rate payments in return for the introduction of beneficial environmental management systems), and assistance for organic conversion.

Showing that joined-up working is possible in Whitehall, we have a whole raft of strategies and actions plans being developed, facilitated or encouraged by DEFRA civil servants. However, we do need to see some outcomes that really demonstrate genuinely joined-up thinking. On an optimistic note, the Framework for Sustainable Development in government now includes a green procurement policy (which could give a much needed push to sourcing of local foods by the public sector). And the Food Industry Sustainability Strategy (FISS) has enormous potential to move producers, manufacturers, and retailers closer together. I only wish somebody would move it along a bit faster.

Bear in mind too, the government’s Public Health white paper with a strong healthy eating theme, because of the rising levels of obesity in the country, coupled with the Department of Health’s long awaited Food and Health Action plan.

Clearly this constitutes a fairly broad range of political drivers with the potential for some to conflict, some to overlap, and for the sheer volume to confuse. This carries risks: for example we have only partial decoupling (e.g. not for all commodities) which will mean continued distortions in the market, and farmers receiving mixed messages about the purpose of reform.

How retailing trends drive agriculture

It is only right that I also mention the role, and somewhat significant power wielded by the retailers. The politicians do indeed have many tools at their disposal to intervene in the market. But by and large they tend to signal the need for and encourage change via voluntary measures – like the FSA’s recent work to get the industry (retailers & manufacturers) to reduce salt content in their processed food ranges. I would like to touch on some of the competitive drivers in the wider grocery market, which as we all know is dominated by the big supermarkets who in turn shape the experience of consumers. These six drivers are:

1. **Access:** continued development of large out-of-town one-stop shopping stores means many small communities are now “access poor”.
2. **Availability:** larger superstores offer wide selection of products, shelves often well stocked with year round availability rather than just seasonal

- foods.
3. **Choice:** sectors and categories are carefully segmented to target different consumers e.g. value and premium ranges, healthy eating ranges, specialist diets, allergy ranges and so on.
 4. **Convenience:** including the rise of ready meals and ready prepared raw foods like pre-washed and sliced veg.
 5. **Price:** supermarkets under intense pressure to produce more for less and inevitably put the squeeze on the supply chain and prices at the farm gate.

Connecting with consumers

What Curry said was that:

“.....farming has become detached from the rest of the economy and the environment.”

and

“developments in the farming and food industry are lagging behind changes in consumer lifestyles and purchasing habits”

The general consensus was that consumers, most notably the young, knew very little about on-farm practices. The story doing the rounds at the time was of a young person being asked, “where does milk come from?” and answering “from the supermarket”. Depending on who told you the story, you can substitute bacon, steak, etc.!

I’m not sure where this quote originally came from but it certainly implies that consumers neither know nor care, not something that we at NCC, who also have to connect with consumers, necessarily recognise. During the Curry consultation period connection is exactly what we did. For example we hosted two “Weekend aways” at which we brought together disadvantaged consumers in what is styled “a participative event”. Comments such as “*we are not apathetic, but we are frustrated.*” [Marian Bailey, North East workshop] enabled us to bring to life our submission to Curry. We learned also how consumers care deeply about the food that they eat and how it is produced. Their concern ranged far beyond merely ensuring affordable food was on the table.

But for farmers their relationship with consumers is more complex. They have to take account of the trends and the drivers I touched upon earlier, whilst trying to keep their heads above water.

Opportunities

There are opportunities, and Curry has helped to identify some of these – public health and nutrition being highly significant. Curry also identified where farmers were poorly served, which included, for example, access to technical advice and market/consumer intelligence. The Food Chain Centre whose mission it is to support the most efficient UK food chain with the most effective flow of information was set up partly with this in mind. One focus

has been to help equip farmers with the right business tools such as benchmarking or working out ways to get consumer information to farmers, for example by using the data from a major supermarket's loyalty card scheme to see how this can inform business planning in future years. It has been very encouraging to see the increase in benchmarking activity. Our first survey in 2002 suggested that 9% of farmers were involved in benchmarking: by 2004 this figure had increased to 24%.

Plumgarths

In a competitive market there will always be winners and losers. One impressive win is illustrated by the success of "Plumgarths" - a progressive Cumbrian family farming business, managed by John Geldard, and based on traditional added value livestock enterprises. John's latest venture, the Plumgarths/ASDA Local Sourcing Initiative was officially launched in September 2002 by Don Curry to provide a route to market for 19 of Cumbria's small-scale food producers supplying more than 80 products. And it's thanks to his long working relationship with ASDA that enabled the initiative to develop further - retailing free range eggs and helping to establish a Farmers' Market within ASDA Kendal store, the first successful venture of its kind in Cumbria. For me this illustrates perfectly the value of innovation and reconnection.

Nutrition

Looking back, it is interesting that it was not self-evident that nutrition should be included in the Curry report, especially as it was not in the original remit. Now of course, it is at the top of the political agenda. And it is one of the areas where I feel farmers can reconnect to consumers and their wider local community. Perhaps we should remind ourselves first of the statistics – statistics which are so worrying that they prompted Sir John Krebs to say that we could be looking at a future where children's life expectancy was less than their parents. Obesity has trebled since the 1980's, 22 per cent of men and 23.5 per cent of women are overweight or obese, as are 17 per cent of children between the ages of 2-15 years.

The government has finally woken up to this, so any farmers looking for market intelligence and for clues about consumer demand in the future should look carefully at both the Public Health white paper and DoH's Food and Health Action plan [when it eventually sees the light of day]. One only has to look at what the investment bankers have said about risks to the stock market valuations based on product portfolios to know which way the wind is blowing!

The supermarkets have long seen the potential for healthy eating ranges – witness the brands and plethora of logos with attached claims [*"Be good to yourself"*, Sainsbury's]. But for many farmers the emphasis really is about reconnecting to the local community through your local schools and hospitals. However you analyse the problem, it has to make more sense that food is best consumed close to where it has been produced - for both nutritional quality and sustainability reasons.

We have already witnessed the rise in farmers markets from little more

than 200 to around 475 (NFU, July 04); box schemes and other direct sales are also helping the situation.

Responsibility

Clearly, retailers, manufacturers and government can do more. But public procurement of food has a critical role to play. If we can get this element right, for example by including a better nutritional balance and the incorporation of sustainability criteria in purchasing decisions, then we improve the economic health of farmers and the physical health of consumers. It is therefore encouraging that government has recently published guidance on how government bodies can carry out the procurement of goods and services in a manner that supports their policy and objectives for sustainable development.

The retailers and the food service industry present different features. The market may be intensely competitive, but this does not mean that the retailers should not behave responsibly. They also need to look carefully at sustainability issues, where they source foods and the effects on the environment of buying and flying food from the other side of the world. In a world in which business strives for ever-greater price reductions we could perhaps learn a bit from the fair trade sector, the principles of which are pretty sound. That is, paying a fair wage and not exploiting one's buying power and strength in the marketplace, while seeking to ensure that the environment in which workers and their families operate are reasonable.

Consumers too have their part to play. For many consumers price is key. For others, they will want different aspects of quality. For consumers to be able to behave responsibly, it is critical that they have access to the right information. Our research shows that consumers are currently very confused by the variety of labelling schemes, but that they are keen to have useful shortcuts to guide them in their buying decisions. This suggests that it would be sensible for the collective industry to put its weight behind the Little Red Tractor scheme, but with the important proviso that you must be sure that the scheme reflects what consumers actually want.

Final thoughts

And some final thoughts to conclude:

- Curry provided a vision.
- As we move forward it is clear there will be winners and losers.
- Consumer choice, markets and trends will each play a part in deciding who the winners are as will government, manufacturers and retailers policies.
- Sustainability considerations will increasingly play a part, as will nutrition.
- Winners will be better connected and adapt and embrace change;
 - o They will be business savvy,

- o Responsive to customer needs,
- o Innovative,
- o Part of highly competitive food chain.

I have given you some interesting examples of successful initiatives. I would contend that all of these have one thing in common and that is that they respond very acutely to consumer needs.

Consumers are becoming increasingly sensitized to food, sustainability and health issues. That provides opportunities for the industry but it is a complex and differentiated market. So there is no one right answer to re-connection, except that there are opportunities out there and that they will be realized by those farmers who are able to understand what consumers want and to deliver it.

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Biographical Notes

Deirdre Hutton DBE became Chair of the Food Standards Agency in July 2005. She has served on a number of public bodies and has considerable experience of corporate governance, risk-based regulation and consumer policy. She is Vice-Chair of the European Food Safety Authority Management Board and Deputy Chair of the Financial Services Authority. For five years, she was Chair of the National Consumer Council, having formerly chaired the Scottish Consumer Council. Prior to her appointment at the Food Standards Agency, she was a member of the Better Regulation Task Force. She has held a number of positions on bodies dealing with food issues, including Chair of the Foresight Panel on the Food Chain and Crops for Industry, Chair of the Food Chain Centre, and membership of the Policy Commission on the Future of Farming and Food (the Curry Commission).

CONFERENCE REVIEW

**THE THIRD FARM MANAGEMENT LECTURERS
CONFERENCE:
HARPER ADAMS UNIVERSITY COLLEGE 11-12 APRIL
2005**

Graham Tate, Julian Park and Ian Edwards

The move north from the previous venue of Duchy College in 2003 was met with predictably poorer weather, but this did little to depress the spirits of the 26 delegates who had been promised a two day programme with three distinctive themes: the water framework directive; the mid-term review and the new environmental stewardship scheme; and teaching entrepreneurship in farm management. The aims of the conference have evolved over the previous meetings in 1998 and 2003 into a friendly discourse on farm management teaching, research and reach-out, delivered by a combination of lectures, visits and contact with other practitioners in agricultural education. However 2005 brought with it its own agenda, and to some extent educational issues were overshadowed by recent changes in agricultural and environmental policy and their implication for farm and agricultural management.

Brian Revell gave the official welcome to the delegates on behalf of Harper Adams. In a short account he charted the development of the farm management discipline from the heyday of the 1970s - with its fashion for gross margins and modelling - through somewhat less fruitful years to the subsequent rise of the discipline of agricultural economics. In his view, the MTR and the changes in agri-environmental policy were opportunities, bringing with them a new impetus and focus on farm level decision making in the new decoupled and environmentally aware agricultural business world.

Theme one, led by Julian Park from the University of Reading, addressed 'The farm management implications of diffuse water pollution' arising from the Water Framework Directive (WFD). This session focussed on issues relating to diffuse water pollution and the new concept of catchment sensitive farming. A key reason for including this topic on the programme was the need for farmers to assess the return from investments required to comply with the WFD, for example investments in effluent handling often have long payback period and for many farmers this level of investment may cause a fundamental re-appraisal of the whole business plan. Tim Pickering and Sharon Chisholm of the Environment Agency discussed these and other topics before leading a walk around the Harper Adams Farm. Assisted by farm manager Scott Kirby, they outlined good practice in relation to the newly installed slurry handling system, surplus spray and spray tank washing procedures, and assessed the potential for soil erosion on land freshly drilled with sugar beet.

The afternoon session, focussed around the question 'Environmental stewardship and cross-compliance - which way now?', was led by Graham Tate. This theme has emerged from a number of Defra cross-compliance workshops convened by Harper Adams and the Royal Agricultural College over the previous winter. These workshops highlighted the concerns of

farmers who might consider complying with both cross-compliance and the Entry Level Stewardship schemes. Joanne Round of Defra Rural Development Service led a session describing how farmers could comply with the two schemes and the opportunities arising from joining both. For example, the rules relating to headland width were discussed from the perspective of farmers participating in the stewardship scheme but who also intended to comply with the cross-compliance regulations so as to qualify for the single farm payment.

A visit to Neil Furniss's Caynton House Farm followed. Neil, the local FWAG chairman, had been successfully combining a Countryside Stewardship Scheme (CSS) with the demands of an East Shropshire arable farming regime. He discussed issues which in his opinion would lead to a successful application under the environmental stewardship scheme, and considered how such an application related to his existing CSS arrangements and cross-compliance obligations.

An informal conference dinner followed with the menu being sourced from the West Midlands area; informal networking in the bar afterwards rounded off a busy day.

On the second day Ian Edwards from the University of Aberdeen introduced the third theme, 'Entrepreneurship and farm management'. This theme has grown from government exhortations (now backed by hard cash) for education to adhere more to business principles - not just in teaching but in conducting relationships with other stakeholders and in acting as both a business partner and catalyst for technology transfer. Bill Slee of the University of Gloucestershire presented evidence that the prosperity in the countryside was more likely to develop alongside a rural economy with a strong knowledge base. He described certain indicators - such as ICT awareness and graduate migration - that were now accepted indicators of growth or decline of the knowledge base.

Eric Howell from the Higher Education Innovation Funded (HEIF) National Rural Knowledge Exchange discussed technology transfer in rural areas. He outlined what 'knowledge exchanges' were, the concept of a rural knowledge supply chain and the launch of the National Rural Web Portal designed to support the positive development of the rural knowledge supply chain (further details of which are available at www.cfri.co.uk).

Tahir Rehman of the University of Reading rounded off the theme by providing an insight into the teaching of entrepreneurship at Reading. He discussed the methods he uses and the challenges teaching this subject poses. Providing the right learning environment - in terms of resources and direction - were, in his view, central to the success of delivering his entrepreneurship module.

Finally, David Ansell, Director of the Institute of Agricultural Management, highlighted a number of areas where the Institute was making a contribution to the development of the subject through the increasingly popular Farm Planner inter-college competition, the availability of membership and the benefits derived from it, and the forthcoming International Farm Management Association conference at Campinas in Brazil in August 2005.

It is hoped to hold the next farm management lecturers conference in April

2007. Anybody who is interested and not already on the mailing list do please contact Graham Tate at Harper Adams University College.

Biographical Notes

Dr Graham Tate is currently Lecturer in Farm Business Management at Harper Adams University College and a member of the Council of the Institute of Agricultural Management under whose auspices the conference was held (email gjtate@harper-adams.ac.uk).

Julian Park lectures and researches in Agricultural Systems at the University of Reading and a member of the University Farm Management Unit.

Ian Edwards is a Lecturer in Farm Business Management at the University of Aberdeen.

ABSTRACTS

This small selection of Abstracts from 'World Agricultural Economics and Rural Sociology Abstracts' is reproduced by kind permission of the CAB International, Wallingford, OX10 8DE from whom details of WAERSA and other CABI publications may be obtained.

2057 SLEE, B.; ROBERTS, D.; EVANS, R. **Forestry in the rural economy: a new approach to assessing the impact of forestry on rural development.** *Forestry (Oxford)* (2004) 77 (5) 441-453 Oxford, UK; Oxford University Press [En, 26 ref.] Countryside and Community Research Unit, University of Gloucestershire, Cheltenham GL50 4AZ, UK. Email: bslee@glos.ac.uk

Forestry contributes to the rural economy in a number of ways: directly as a user of land and resources to transform biological and other inputs into a range of outputs; indirectly through its linkages with upstream suppliers and downstream processing sectors; through the re-spending in rural areas of parts of income derived from forestry and its related industries; through the provision of non-market benefits; and in more opaque, though nonetheless important ways, in providing a desirable location for non-forestry-related business activity and a living environment which many people find attractive. The full range of these economic benefits can be more or less easily enumerated and are likely to vary very substantially from one region to another. In some areas, the forest production sector may be the greater contributor to rural economic well-being; in others the local forest-dependent spending associated with firms and households living in a tree-rich environment might contribute more to local economies than the benefits arising from production forestry. This points to the need for a strong degree of regional, and perhaps more local, differentiation in forest policy and practice, based on a sound knowledge of the relative contributions of different benefit streams (and costs) in particular locations and of the potential trade-offs between production and amenity. This paper presents a new approach to estimating the impact of forestry on rural development and applies this to a case-study area in England.

2239 KIRWAN, J. **Alternative strategies in the UK agro-food system: interrogating the alterity of farmers' markets.** *Sociologia Ruralis* (2004) 44 (4) 395-415 Oxford, UK; Blackwell Publishing [En, many ref.] Countryside and Community Research Unit, University of Gloucestershire, Francis Close Hall, Swindon Road, Cheltenham, Gloucestershire GL50 4AZ, UK.

In recent years, numerous alternative strategies have developed within the UK agro-food system intent on overcoming, or at least circumventing, some of the problems associated with the globalization of food production and consumption. Within these alternative strategies, there is an intention to reconnect food to the social, cultural and environmental context of its production, leading to considerable interest in their potential to engender sustained change within the food system. However, it is apparent that alternative strategies are likely to face various pressures on their underlying integrity and alterity, and their possible re-incorporation within mainstream processes. There is a need, therefore, to interrogate the durability of alternative strategies, which this paper does through its critical examination of farmers' markets (FMs). Drawing upon a number of FM case studies, it examines the engagement of producers and consumers, both with each other, but also with the exchange context of FMs. The resultant data are assessed within the conceptual domains of embeddedness and regarded as a means of better understanding the nature of FMs as an alternative strategy. The paper concludes by outlining the implications of this research for the comprehension of alternative strategies more broadly.

2610 BOLAND, M. A.; AKRIDGE, J. T. **Undergraduate agribusiness programs: focus or falter? Review of Agricultural Economics (Boston)** (2004) 26 (4) 564-578 Boston, USA; Blackwell Publishing [En, 14 ref.] Kansas State University, Manhattan, KS 66506, USA.

This paper considers whether agribusiness undergraduate programmes in the USA will continue to serve the needs of both industry and students in the future. It is argued that to survive and thrive, agribusiness programmes must pursue an aggressive niche strategy. Programmes must be more than collections of courses; they must be coordinated, integrated

experiences that foster critical thinking and communication skills, develop industry-specific knowledge, and cultivate diversity of thought. It is suggested that the agricultural economics heritage of most programmes can be used as a point of difference. Programmes must pursue partnerships with industry and other academic programmes, and faculty development must be a priority.

2682 SHIFERAW, B.; FREEMAN, H. A.; SWINTON, S. M. **Natural resource management in agriculture: methods for assessing economic and environmental impacts.** Wallingford, UK; CABI Publishing (2005) xvi + 382 pp. ISBN 0-85199-828-3 [En, many ref.] International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), PO Box 39063, Nairobi, Kenya. Email: b.shiferaw@cgiar.org, h.a.freeman@cgiar.org, swintons@msu.edu

This book examines methodological difficulties and presents practical methods that can be used in the assessment of the economic and environmental impacts of natural resource management (NRM) in agriculture. Following an introduction, part II (chapters 2-5) examines the valuation of ecosystem services and the measurement of biophysical indicators of NRM impacts. Part III (chapters 6-8) introduces advances in methods used to evaluate the economic and environmental impacts of NRM technology and policy interventions. Part IV (chapters 9-13) deals with NRM impact assessment in practice. Five case studies illustrate the methodological advances discussed in part III. Finally, part V (chapters 14-16) highlights some of the existing controversies and outlines best practices, research issues, and recommendations for NRM impact assessment into the future. The book has a subject index.

2688 BISHOP, K.; PHILLIPS, A. **Countryside planning: new approaches to management and conservation.** London UK-Earthscan (2004) xviii + 278 pp. ISBN 1-85383-849-7 [En, many ret.] Welsh Local Government Association, Local Government House, Drake Walk, Cardiff CF10 4LG, UK.

This book documents the global drivers, the attempts at joined-up thinking, and the local action that are all features of countryside planning and management in the UK. Part 1 (chapters 2-5) looks at the international context for countryside planning. It covers the Convention on Biological Diversity, the EU Birds and Habitats Directive, the harnessing of landscape as an international policy instrument; and the European and global drivers for community involvement in countryside planning. By reference to experience in England, Ireland, Scotland and Wales, part 2 (chapters 6-12) examines in detail a range of the new approaches to countryside planning and nature conservation, the thinking behind these, their proposed and actual uses, and their effectiveness. Such approaches include landscape characterization and assessment methodologies including the LANDMAP tool. Part 3 (chapters 13-16) explores through the use of several case studies, the practical use of these new approaches.

3373 BRUHNS, J.; BARON, O.; MAIER, K. **Sugar Economy Europe 2005.** Berlin, Germany; Verlag Dr. Albert Bartens KG f2004) Ed 51 424 pp. ISBN 3-87040-102-8 [En]

The first part of this book contains statistics on the activities of the world's sugar industry (production, consumption, trade etc. and in considerably greater detail, on the European sugar industry (with specific sections on Germany and France). The tables are labelled in German, English and French. The second section lists sugar industry companies, organizations and factories, with their addresses, in each country in Europe (as well as international ones), with a specific section (partly in German) on Germany. The 3rd section describes the European Union sugar regulations the international Sugar Agreement and several sugar futures contracts.

3657 FOUSEKIS, P.; REVELL, B. **Food scares, advertising, and the demand for meat cuts in Great Britain.** *Acta Agricultura Scandinavica. Section C, Food Economics* (2004) 1 (3) 121-136 Basingstoke, UK; Taylor & Francis Ltd [En, 42 ref.] Department of International Economics and Political Science, University of Macedonia, Thessaloniki, Greece.

Retail demand systems for 19 different cuts of meat for beef, lamb, pork, bacon and poultry in Great Britain are estimated from monthly time series of consumer expenditure from 1989-2000 using a two stage budget allocation process and an LA/AIDS specification. The unconditional expenditure, own and cross price elasticities are derived for the individual meat

cuts. The impact of adverse publicity from meat scares, especially BSE, and of positive publicity through consumer promotion and advertising are incorporated into the modelling. Meat scares produced a reallocation of consumer spending from red to white meats during the 1990s. The impact of species-based advertising was shown to have complex spill over effects both within and between meat species, and the response of consumer demand to advertising was considerably less than to adverse publicity.

3659 BALTZER, K. **Consumers' willingness to pay for food quality — the case of eggs.** *Acta Agriculture Scandinavica. Section C, Economy* (2004) 1 (2) 78-90 Basingstoke, UK; Taylor & Francis Ltd [En, 22 ref., Special issue: Marketing quality food products] The Royal Veterinary and Agricultural University, Danish Research Institute of Food Economics (FOI), Rolighedsvej 25, DK-1958 Frederiksberg C, Denmark. Email: kb@foi.dk

This paper introduces an approach to estimating the marginal willingness to pay (WTP) for food quality and safety using data on actual consumer purchases. Marginal WTP for specific food product varieties can be derived from estimated demand functions by inverting the relations, thereby expressing the prices consumers are willing to pay as functions of quantity demanded. The task addressed in the paper is the isolation of the WTP for quality attributes embedded in the varieties. Two models based on the AIDS-specification are proposed and discussed. To illustrate the applicability of the models, the case of five varieties of eggs in Denmark is presented. The data set used in the analysis comprises information on weekly sales of the five varieties of eggs in 930 stores in the period January 2000-June 2002. It is found that Danish consumers are willing to pay a relatively high premium for improved animal welfare and organic production methods and somewhat less for food safety.

3664 ALFNES, F.; RICKERTSEN, K. **European consumers' acceptance of US hormone-treated beef.** *Eurochoices* (2004) 3 (3) 18-23 Uckfield, UK; Agricultural Economics Society and the European Association of Agricultural Economists [En, de, fr] Department of Economics and Resource Management, Agricultural University of Norway (NLH), P.O. Box 5033, As, N-1432 Oslo, Norway. Email: frode.alfnes@ior.nlh.no, kyrre.rickertsen@ior.nlh.no

The European Union's ban on hormone-treated beef is one of the most contentious trade disputes between the USA and the EU. The EU claims that consumption of hormone-treated beef constitutes a possible risk to human health and, moreover, that European consumers are unwilling to accept such a risk. On the other hand, the USA claims that the ban is a protectionist measure. The World Trade Organization has ruled in favour of the USA, saying that there is insufficient scientific evidence to support the ban. The effects on human health can only be evaluated through more medical research but surveys and methods from experimental economics can be used to investigate consumers' acceptance and willingness to pay (WTP) for hormone-treated beef. European surveys show that the average consumer is sceptical towards hormone-treated beef. In experimental auctions conducted in Norway, most of the 106 participants bid significantly less for US hormone-treated than hormone-free beef. However, 18% were indifferent and 10% of the participants preferred the hormone-treated beef. Given this heterogeneity of preferences, it is argued that mandatory labelling is a possible solution to the trade dispute. Mandatory labelling, however, has met stern opposition from both sides and no solution to the dispute seems to be close.

3669 OMAR, O. E.; HIRST, A.; BLANKSON, C. **Food shopping' behavior among ethnic and non-ethnic communities in Britain** *Journal of Food Products Marketing* (2004) 10 (4) 39-57 Binghamton, USA; Food Products Press [En, 43 ref.] Division of Marketing, South Bank University Business School, London, UK. Email: o m a r o e @ s b u . a c . u k , hirst@sbu.ac.uk, Charles.Blankson@liu.edu

This study compares ethnic and non-ethnic grocery shoppers (n=604; 204 were members of ethnic minorities) to establish if their brand preferences differ while shopping in British supermarkets. It is thus an investigation useful for grocery brand positioning. While this study found that grocery shoppers differ in terms of socio-economic status, personal characteristics and brand preference behaviour, no significant differences were found in the preference of food brands because of cultural differences. In terms of brand name importance, the results suggests, that statistically, no significant cultural differences exist in the level of importance that consumer groups attached to a variety of food brand attributes. The results however found

that, when purchasing fruit and vegetables, rice, meat and fish, non-ethnic consumers disliked "no-name" brands and attached greater importance to national brands than did the ethnic consumers. A substantial majority of both the ethnic and non-ethnic consumers perceived television and radio information sources as of very little importance. The majority of the ethnic consumers found ethnic-minority based newspapers to be an important source of food information. Implications for brand image, the buying preferences for ethnic and non-ethnic consumers, grocery retailing, limitations and future research directions are discussed.

3886 BONT, C. J. A. M. DE; BOLHUIS, J.; BOONE, J. A.; EVERDINGEN, W. H.; JAGER, J. H.; OLTMER, K. **Market signals for organic farming.** *Rapport - Landbouw-Economisch Instituut (LEI)* (2005) No.2.05.03, 69 pp. ISBN 90-5242-974-x Den Haag, Netherlands; Landbouw-Economisch Instituut (LEI) [En, 33 ref.] Agricultural Economics Research Institute (LEI), Burgemeester Patijnlaan 19, P.O. Box 29703, 2502 LS The Hague, Netherlands.

Using FADN data from member countries of the EU-15, this report provides information on (1) the relationship between the prices of organic products and prices of conventional products; and (2) the economic results of organic farms compared to similar sized conventional farms in two types of farming (grazing livestock and field crops). Given the lack of data on prices and farmers' income on organic production for a lot of member countries, farm products/sectors and types of farming, this report also presents ideas and proposals on what is desired and what is feasible in future farm accounting.

3887 MILLER, A.; DOBBINS, C.; PRITCHETT, J.; BOEHLJE, M.; EHMKE, C. **Risk management for farmers.** *Staff Paper -Department of Agricultural Economics, Purdue University* (2004) No.04-11, 31 pp. West Lafayette, USA; Department of Agricultural Economics, Purdue University [En] Department of Agricultural Economics, Purdue University, West Lafayette, IN 47907-1145, USA. Email: millerwa@purdue.edu

Risk is present in all decisions, though often its assessment is skewed to the negative effects. This paper presents material on the sources of risk in agriculture, procedures for managing two types of risks (operational and strategic) and the interaction of time and risk.

3933 Williams, H.; REEVES, N.; JONES, D.; Morris, W. **The economics of lowland beef production in England, 2003 — a report on the results of a special study of lowland beef enterprises in England.** *Special Studies in Agricultural Economics* (2005) No.62, xiv + 121 pp. Exeter, UK; Agricultural Economics Unit, University of Exeter [En, 13 ref.] Farm Business Survey, Institute of Rural Sciences, The University of Wales, Aberystwyth, Llanbadarn Campus, Aberystwyth SY23 SAL, UK.

This report presents the results of a survey of 322 lowland beef enterprises in England, UK. Data are presented on the general characteristics of the UK beef sector; the farm management practices of the surveyed enterprises; the output, variable costs, fixed costs, and gross margins in 2003 of the suckler herds and trading enterprises surveyed; and the attitudes of farmers about the future direction of their beef enterprise. It is concluded that the output of lowland beef enterprises in England needs to be increased for them to be profitable in light of the forthcoming decoupling of headage payments.

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EDITORIAL

The editorial policy of the Journal is established by the Editorial Committee. As previously stated current Committee is continuing to develop the approach taken under the Chairmanship of Martyn Warren by welcoming papers which describe and analyse farm business and management practices and performance from around the world. It is important, however, that wherever possible, papers show how the methodology, principles and propositions they use and develop are of relevance to farm and land managers of other farming systems.

This issue reflects these policies and practices. It includes two refereed papers, one by Crosson and colleagues based on suckler beef production systems in Ireland, the other by Lien and colleagues compares organic, integrated and conventional cropping systems in Norway. These are accompanied by a conference paper by Sïon Roberts which considers British farmers involvement with collaborative supply chain management. Matthew Naylor was a delegate to the 15th International Farm Management Association's Congress which met in August 2005 in Brazil, and he has submitted a review of that Congress.

Finally, there is the regularly published abstracts of research papers and articles. This provides a diverse collection of articles which it is hoped will offer something of interest to most readers and shows our intent to look for good papers from a wide range of geographical areas and farming systems.

This year two stalwarts of the Editorial Committee, David Gardner and Lester Bowker, decided to step down from the Committee. Both have been long-serving members and have made many valuable contributions to the strategic development of the journal and to improving papers they were asked to review. Both are heavily involved in the practicalities of farming and this has show in their comments and advice. They have been particularly important in ensuring that articles and papers have the wellbeing of farming businesses and of the farming and rural community at heart. It will be particularly important for the Editorial Committee to continue to ensure that papers published in the journal continue to meet these objectives.

Jeremy Franks

Editor

REFEREED PAPER

INVESTIGATING DEVELOPMENT OPTIONS FOR IRISH SUCKLER BEEF PRODUCERS USING MATHEMATICAL PROGRAMMING*Crosson P., O'Kiely P., O'Mara F.P. and Wallace M.*

Changes in European agricultural policy brought about by the Luxembourg Agreement of 2003 have led to a new environment within which Irish farmers seek to make adequate profits from beef production. A mathematical programming model, the Grange Beef Model, is used to investigate the impact of farm developments on the profitability of beef farms in Ireland within the policy environment of the Luxembourg Agreement. The scenarios investigated include expansion with and without development of fixed capital resources. Results indicate that farm margins and cash flows will come under increasing pressure in the years 2005 to 2012. Expansion may be hindered by high costs associated with these scenarios. De-stocking may prove preferable given the reduced labour requirements enabling possible uptake of off-farm employment.

Keywords: mathematical model; Luxembourg Agreement; beef; production systems; development options.

Introduction

Beef produced in Ireland is sourced from the national cow-herd of 2.4m of which approximately half are beef-breed cows (CSO, 2004). Beef output is predominantly derived from grazed and ensiled grass as these have been the cheapest forms of feed available. Cattle are finished at a variety of ages depending on EU premia requirements, prevailing beef price, animal type and on-farm conditions. In 2002 cattle output was valued at €1.2bn representing 20% of total agricultural output (CSO, 2004). When export refunds are included, exports in 2002 were also valued at almost €1.2bn representing 17% of total agri-food exports (Department of Agriculture and Food, 2004). Ireland is a major exporter of beef with the European Union (EU) representing the major export destination of Irish beef. For example, in the UK and the Netherlands, Irish beef accounts for 28% and 7% respectively of total beef imports (Department of Agriculture and Food, 2004). In addition, in 2002 live cattle exports were valued at €105m. Consequently, Irish beef farming makes a major contribution to agricultural and overall national earnings.

Farmers who operated within the EU Agenda 2000 Common Agricultural Policy (CAP) regime received headage payments on eligible animals. The Luxembourg CAP reform Agreement (LA) shifts support payments from a per animal basis to a single payment based, in Ireland's case, on the area of land farmed between 2000 and 2002 and historical payments for these years, a process known as decoupling. These support payments came into effect on 1 January 2005 and are referred to as single farm payments (SFP). The entitlements will be reduced by 3% in 2005, 4% in 2006 and 5% in 2007 in each EU country in a process known as modulation which will redistribute funds to the CAP Rural Development Programme. The first €5,000 of each farmer's entitlement is exempt from modulation. This shift in the form of farm subsidies allied to uncertainty with regard to future beef prices has made future expansion at farm level somewhat speculative. The SFP also creates the

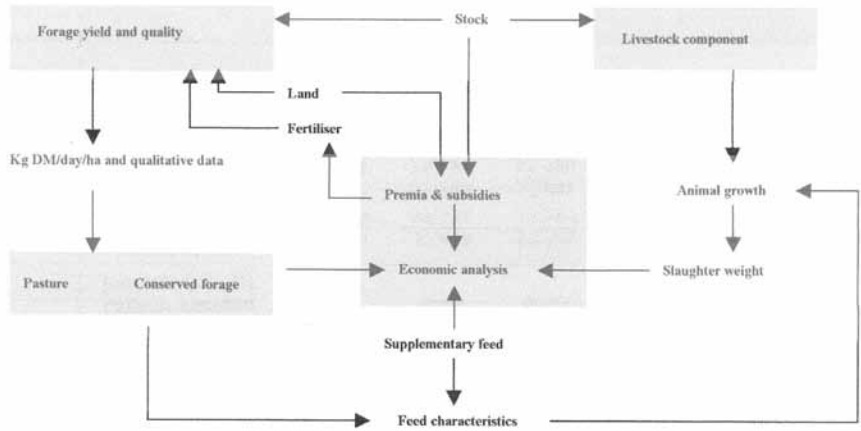
danger of accentuating cash flow difficulties since it will arrive in one payment rather than a number of smaller payments throughout the year as was previously the case under Agenda 2000.

The Food and Agricultural Policy Research Institute (FAPRI) predicts that suckler cow numbers will decrease by 22% by 2012 relative to 2002 levels (Binfield et al., 2003). It is thus evident that many smaller or less efficient farmers will cease production and retire completely from farming and sell their holding or become “entitlement farmers” thereby collecting their entitlements without stocking their farms to any significant degree. Those farmers who elect to continue in beef production will most likely seek to expand their enterprises to attain economies of scale.

A number of alternatives are available to farmers who wish to expand their business. Some farmers will have surplus capacity in terms of land and wintering facilities and will be able to expand their beef enterprise without any capital development requirements. The majority of farms, however, will require upgrading of existing animal accommodation facilities to enable herd expansion. Low-cost accommodation options have recently been developed to facilitate cost-effective expansion of livestock enterprises. From an Irish perspective the most encouraging low-cost options are out-wintering pads (French and Hickey, 2004) and earth bank animal manure storage tanks (Scully et al., 2002). Both these options may serve as an alternative to the traditional and more expensive option of slatted-floor sheds with underground concrete slurry storage tanks.

This paper presents the results of a study in which a number of development options in this new policy scenario were investigated. To enable rapid, repeatable and consistent comparison of farm development options an optimization model, the Grange Beef Model (Crosson et al., 2006) was used. Five farm development scenarios were investigated representing a static scenario, a de-stocking scenario and three expansion scenarios. The technical and financial implications of these options are presented.

Figure 1. Schematic outline of the Grange Beef Model.



Model specifications

The Grange Beef Model is a linear programming model designed to identify optimal beef production systems given a range of resource and economic parameters (Crosson et al., 2006). The interaction of technical and financial components is a key element of the model (Figure 1). It is constructed around a typical suckler herd based on spring-calving Limousin x (Limousin x Friesian) cows. Included are suckler cow, replacement heifer, calf, store (yearling) and finishing activities. Cows are described as either young (first lactation) or mature (two or more lactations). Replacement heifers first calve at 24 months of age. Nutritional specifications are described in terms of energy requirements and intake capacity. Intake is energy driven but is potentially limited by physical fill.

The feeding activities available are based on pasture, grass silage and concentrates. Due to the predominance of pasture-based systems in Ireland, the model specifies a detailed set of grazing options typical of those available to Irish cattle farmers. Grass silage and concentrate feeding activities are included to facilitate winter feeding and feeding in periods of temporary grass shortage during the grazing season. Forage production is based on historical Irish yield data with key nutritional variables taken from INRAtion (INRA, 2003).

Budgets are formulated for each activity using the most recently available Irish data (Teagasc, 2004). These budgets assign a cost or revenue to each activity and, based on these, the program identifies the optimal net farm margin. Overhead costs are handled externally and are based on farm type and size (Teagasc, 2004). In the scenarios investigated, interest and principal payments on loans for expansion and development are categorised as overhead costs. Depreciation costs for existing and additional capital assets are categorised as expenses in the trading, profit and loss account in the calculation of farm net profit. Land rental and hiring of labour are modelled activities and the costs arising from these activities are handled internally within the model and are categorized in the results presented as variable costs.

With regard to cash flow, each model activity is associated with a financial budget (Teagasc, 2004) that determines the cost or revenue imputed to the activity. For the purposes of cash flow, the budgets are allocated according to the timing of receipts and payments. Transfer rows transmit surpluses or deficits to subsequent months. Deficit balances are also transferred into overdraft rows, which impose a charge on the overdraft (interest). This overdraft row also imposes limits on the maximum overdraft allowed which is set by the user. Surplus balances also attract interest albeit at a lower rate.

The model is solved using the optimisation software “What’s Best!” (Lindo Systems Inc., 2002). It was designed in Microsoft Excel and consists of 1009 activities and 425 constraints and ties. The intersect values of the activities and the constraints are termed the “coefficients” of the model with the suite of coefficients within the linear programming structure termed the “model matrix”. To facilitate the development scenarios investigated, end of year cash balances, stock inventory changes, yearling cattle numbers and store cattle numbers are used as input parameters for subsequent years and the model is re-solved. Other year-dependent parameters not dependent on the

operation of the farm in the previous year, such as the single farm payment and loan repayments, are calculated in a “scenario” worksheet. Since suckler cow numbers, and hence calf numbers, are a function of the scenarios investigated, these values are specified in the scenario worksheet, are read directly into the linear programming matrix and are unchangeable within each model solution. The model thus identifies the optimal feeding system, nitrogen application policy and finishing system for the various systems investigated. The farm modelled at the beginning of all scenarios i.e. in January 2005, is based on an average Irish cattle rearing farm greater than 50 ha as defined by the National Farm Survey (Connolly et al., 2004). The farm size is 65 ha with 38 suckler cows. Based on Irish agricultural census data (CSO, 2004) this group of cattle farmers with between 30 and 50 cows represent 8.6% of farms with suckler cows but own 23% of the suckler cows in Ireland.

Development scenarios

To investigate optimal systems in developmental scenarios a number of options were investigated for an eight year time horizon, 2005-2012. All scenarios were based on a spring-calving suckler herd. Cows calved in March and were allocated fresh pasture if it was available. Calves were weaned at eight months of age following which both cows and calves were housed for the winter period.

Table 1. Expansion and herd culling and replacement policy.

Base (S1)	2005	2006	2007-2012
Cow numbers	38	38	38
Replacement purchased	6	6	6
Cows culled	6	6	6
Destocking (S2)	2005	2006	2007-2012
Cow numbers	38	28	18
Replacement heifers purchased	0	0	2
Cows culled	10	10	2
Expansion with no capital development¹ (S3)	2005	2006	2007-2012
Cow numbers	38	58	58
Replacement heifers purchased	25	9	9
Cows culled	5	9	9
Expansion with development of SFS² (S4)	2005	2006	2007-2012
Cow numbers	38	58	58
Replacement heifers purchased	25	9	9
Cows culled	5	9	9
Expansion with development of OWP³ (S5)	2005	2006	2007-2012
Cow numbers	38	58	58
Replacement heifers purchased	25	9	9
Cows culled	5	9	9

¹ Assumes surplus capacity in 2005. ² Slatted floor shed. ³ Out-wintering pad.

Five farm development alternatives were investigated. These scenarios were designed to represent options available to beef farmers and are presented in Table 1. Scenario 1 is a static scenario and involves no change in the production system. Table 2 shows the prices and costs used for all scenarios. Beef and cattle prices in 2005 are those values of Teagasc (2004) with price changes through to 2012 taken from projections by FAPRI-Ireland (Binfield et al., 2003). Input costs are subject to inflation at 2.8% per annum. Scenario 2 is a de-stocking scenario whereby cow numbers were reduced from 38 in 2005 to 18 in 2007. Scenarios 3, 4 and 5 are expansion scenarios and involve increases in cow numbers from 38 in 2005 to 58 in 2006. This expansion of approximately 50 per cent represented an aggressive growth strategy within the context of available capital resources. Suckler cow replacements were purchased as in-calf heifers at 22 months of age. This was preferred to rearing replacements since it facilitated rapid expansion. Purchase of replacements was facilitated by means of a term loan (Table 3) payable over five years from 2005 to 2009. In S3 it was assumed that no capital development was required for expansion i.e. surplus capacity existed in 2005, whereas in S4 and S5 capital development was required to facilitate expansion. In the case of S4 capital development was by means of a slatted-floor shed whereas for S5, development was by means of an out-wintering pad for accommodation and an earth bank tank for slurry storage. Both of these development options provide accommodation for 20 additional adult animals.

Table 2. Cost and price projections used.

	2005	2006	2007	2008	2009	2010	2011	2012
Spring beef price (€. kg^{-1})	2.95	2.80	2.86	2.97	3.19	3.48	3.83	4.23
Autumn beef price (€. kg^{-1})	2.85	2.70	2.76	2.87	3.09	3.38	3.73	4.13
Cull cow beef price (€. kg^{-1})	2.15	2.00	2.06	2.17	2.39	2.68	3.03	3.43
Yearling heifer (9 month) price (€)	315.00	264.60	251.90	249.63	260.87	274.17	299.12	327.83
Yearling steer (9 month) price (€)	440.00	352.00	317.50	298.77	297.28	306.49	322.12	340.16
Store heifer (16 month) price (€)	600.00	504.00	479.81	475.49	496.89	522.23	569.75	624.45
Store steer (16 month) price (€)	750.00	600.00	541.20	509.27	506.72	522.43	549.08	579.82
Concentrate cost (€. t^{-1})	200.00	205.60	211.20	216.80	222.40	228.00	233.60	239.20
Urea fertiliser cost (€. t^{-1})	230.00	236.44	242.88	249.32	255.76	262.20	268.64	275.08
CAN ¹ fertiliser cost (€. t^{-1})	220.00	226.16	232.32	238.48	244.64	250.80	256.96	263.12
0-10-20 fertiliser cost (€. t^{-1})	230.00	236.44	242.88	249.32	255.76	262.20	268.64	275.08

¹. Calcium Ammonium Nitrate fertilizer.

Adult animals are classified as suckler cows, replacement heifers and progeny greater than 18 months of age. Animals less than 18 months of age are classified as “young animals”. In model solutions, one adult space can accommodate two young animals thus providing a greater range of potential finishing systems to model solutions. The technical and financial assumptions for these developments are presented in Table 3. No grant aid was assumed and all developments are subject to a 10 year write-off. Economic parameters for the expansion of animal and manure accommodation facilities were taken from Regan (2004).

Table 3. Investment options for the expansion scenarios (S3-S5)

	No commercial development (S3)	Slatted-floor shed. (S4)	Out-wintering pad & earth bank tank (S5)
Number of replacement heifers purchased	25	25	25
Cost of replacements @ €900/heifer (€)	22,500	22,500	22,500
Loan interest	7.5%	7.5%	7.5%
Loan duration (years)	5	5	5
Annual repayments (€)	4,837.50	4,837.50	4,837.50
Building cost (€)	-	21,160	6,140
Loan interest	-	7.5%	7.5%
Duration of loan (years)	-	10	10
Annual repayments (€)	-	2,274.70	660.05
Annual operational cost (€)	-	60.00	400.00

In all scenarios a number of features remained constant:

- An overdraft limit of €30,000 was imposed on the farm. The rate of interest on overdrafts was 7.5%. This overdraft limit was considered an upper limit for farm holdings of this scale. Consequently, increasing overdraft limits above this level was considered unrealistic.
- Opening cash balance in 2005 was €5,000 for all scenarios.
- The entitlements established under the LA were €500ha⁻¹ in 2005. Modulation reduces this by 3% in 2005, 4% in 2006 and 5% in 2007.
- Participation in the Rural Environment Protection Scheme (REPS) was assumed in all cases. REPS involves payments to farmers for carrying out farming activities in an environmentally friendly manner. Farmers participating in REPS receive €200.ha⁻¹ for the first 20ha farmed, €175.ha⁻¹ for the next 20ha, €70.ha⁻¹ for the next 15 and €10.ha⁻¹ for each ha over 55ha.
- Land can be rented in or out at a cost of €267ha⁻¹ for the years 2005 to 2012. This land was rented without any associated single farm payment entitlements. This value represents a significant reduction from 2004 rental prices as is predicted to occur following implementation of LA.
- Family labour availability is 3,000 hours per annum. Additional hired labour is available at €8.60 per hour. Labour costs are subject to inflation at 2.8% per annum.

For the purposes of calculating end-of-year cash balances, it was necessary to specify the contribution of farm income to family living expenses. Family living expenses were estimated to be €27,000 (Teagasc, 2004) in 2005 and were subject to inflation at 2.8% per annum. It is estimated that on 63% of the cattle rearing farms of the size modelled here, the farmer and/or the farmer's spouse has off-farm employment (Connolly et al., 2004). Given that estimated off-farm income for family farms is €20,700 (Connolly et al., 2004), it was assumed that only one third of family living expenses were met by drawings from the farm business each year. Farm profits were also subject to taxation at the Irish tax rates of 20% on profits up to €56,000 and 42% on profits greater than €56,000 with tax payable the subsequent year.

To evaluate the growth of the farm business for the alternative scenarios, assets and liabilities were calculated in balance sheets. From these balance sheets, the growth of the farm business was calculated as the change in net worth. Land was assumed to appreciate in line with inflation whilst buildings and machinery were subject to depreciation at a declining balance rate of 5% and 10% per annum respectively.

Results

The key technical results are presented in Table 4. Production systems for all scenarios were based on finishing heifers at 20 months and finishing steers at 22, 26 or 28 months. Intake of grazed grass was high in all cases with grazed grass accounting for over 60% of the annual feed budget for all years in

Table 4. Technical results.

S 1	2005	2006	2007	2008	2009	2010	2011	2012
Grazed grass fed per cow unit (tDM)	4.8	4.7	4.7	4.7	4.7	4.7	4.7	4.8
Grass silage fed per cow unit (tDM)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Concentrates fed per cow unit	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Inorganic N used (kgN.ha ⁻¹)	24.5	24.5	24.2	24.1	24.1	24.1	24.1	24.0
Total N used (kgN.ha ⁻¹)	111.8	111.8	111.	111.4	111.	111.4	111.4	110.6
Heifers finished (20m)	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Steers finished (28m)	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Labour use (hrs)	2,322	2,329	2,32	2,329	2,32	2,328	2,328	2,328
S 2								
Grazed grass fed per cow unit (tDM)	4.7	5.2	6.1	5.8	5.4	5.4	5.4	5.4
Grass silage fed per cow unit (tDM)	1.8	1.7	1.4	1.2	1.1	1.1	1.1	1.1
Concentrates fed per cow unit	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Inorganic N used (kgN.ha ⁻¹)	23.0	15.6	8.8	7.6	6.6	6.6	6.6	6.6
Total N used (kgN.ha ⁻¹)	104.4	81.3	56.6	50.3	47.1	47.1	47.1	47.1
Heifers finished (20m)	17.0	17.0	12.0	8.0	8.0	8.0	8.0	8.0
Steers finished (22m)	0.0	3.6	8.1	3.1	0.0	0.0	0.0	0.0
Steers finished (26m)	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steers finished (28m)	12.6	13.4	8.9	8.9	8.0	8.0	8.0	8.0
Labour use (hrs)	2,157	1,929	1,70	1,638	1,60	1,600	1,600	1,600
S 3								
Grazed grass fed per cow unit (tDM)	4.7	3.8	3.9	4.3	4.5	4.5	4.5	4.5
Grass silage fed per cow unit (tDM)	2.1	2.3	2.4	2.2	2.2	2.2	2.2	2.2
Concentrates fed per cow unit	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.1
Inorganic N used (kgN.ha ⁻¹)	27.5	47.5	52.0	70.9	80.5	80.6	84.7	84.7
Total N used (kgN.ha ⁻¹)	130.4	166.0	176.	201.1	213.	213.8	217.9	217.9
Heifers finished (20m)	17.0	17.0	26.0	26.0	26.0	26.0	26.0	26.0
Steers finished (22m)	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
Steers finished (26m)	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steers finished (28m)	14.3	17.0	17.0	19.7	26.0	26.0	26.0	26.0
Labour use (hrs)	2,843	2,918	3,00	3,021	3,04	3,045	3,033	3,033

Table 4 continued. Technical results.

S 4	2005	2006	2007	2008	2009	2010	2011	2012
Grazed grass fed per cow unit (tDM)	4.7	3.8	3.9	4.3	4.5	4.5	4.5	4.5
Grass silage fed per cow unit (tDM)	2.1	2.3	2.4	2.2	2.2	2.2	2.2	2.2
Concentrates fed per cow unit (tDM)	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.1
Inorganic N used (kgN.ha ⁻¹)	27.5	47.5	52.0	70.9	80.5	80.5	84.7	84.7
Total N used (kgN.ha ⁻¹)	130.4	166.0	176.9	201.1	213.8	213.8	217.9	217.9
Heifers finished (20m)	17.0	17.0	26.0	26.0	26.0	26.0	26.0	26.0
Steers finished (22m)	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
Steers finished (26m)	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steers finished (28m)	14.3	17.0	17.0	19.7	26.0	26.0	26.0	26.0
Labour use (hrs)	2,843	2,918	3,000	3,021	3,045	3,045	3,033	3,033

S 5

Grazed grass fed per cow unit (tDM)	4.7	3.8	3.9	4.3	4.5	4.5	4.5	4.5
Grass silage fed per cow unit (tDM)	2.1	2.3	2.4	2.2	2.2	2.2	2.2	2.2
Concentrates fed per cow unit (tDM)	0.2	0.1	0.2	0.2	0.2	0.2	0.1	0.1
Inorganic N used (kgN.ha ⁻¹)	27.5	47.5	52.0	70.9	80.5	80.5	84.7	84.7
Total N used (kgN.ha ⁻¹)	130.4	166.0	176.9	201.1	213.8	213.8	217.9	217.9
Heifers finished (20m)	17.0	17.0	26.0	26.0	26.0	26.0	26.0	26.0
Steers finished (22m)	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0
Steers finished (26m)	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Steers finished (28m)	14.3	17.0	17.0	19.7	26.0	26.0	26.0	26.0
Labour use (hrs)	2,843	2,918	3,000	3,021	3,045	3,045	3,033	3,033

all scenarios and over 80% for 2007 to 2012 in S2. N usage is low in all cases particularly for S2 following de-stocking. In the expansion scenarios (S3, S4 and S5), N usage increases but still does not approach the 260kgN.ha⁻¹ limit set by REPS specifications.

In terms of labour requirements, the differences between the scenarios are pronounced. In the base, static scenario (S1) labour requirements are approximately 2,300 hours for all years. This is reduced by over 30% in the de-stocking scenario (S2) from 2008 to 2012. For the expansion scenarios (S3, S4 and S5) the labour requirements are almost 30% greater than S1 and 47% greater than S2 from 2009 to 2012.

Table 5 presents the revenues, costs and margins associated with the five scenarios investigated. The expansion scenarios have the highest revenues following 2006 when revenue is over €55,000 and rises to almost €90,000 in 2012. These scenarios have almost identical revenues illustrating the similarities of the production systems. S2 has the lowest revenue after 2005 dropping to approximately €24,400 in 2009. S1 is intermediate between S2 and the three expansion scenarios in all years except 2005. As expected the expansion scenarios (S3, S4 and S5) incurred the highest variable costs for all years, rising from approximately €30,000 in 2005 to almost €44,000 in 2012. S2 had the lowest variable costs in all years and decreased by over €9,000 between 2005 and 2012. Again, S1 was intermediate between S2 and the expansion scenarios in terms of variable costs. Feed costs and animal expenses represented the main costs in all scenarios.

The net margin figure illustrates the risk associated with expansion but

Table 5: Financial results (all values in €)

S 1	2005	2006	2007	2008	2009	2010	2011	2012
Revenue exc. SFP ¹	46,028	37,986	40,509	42,486	46,117	50,085	55,450	61,146
Variable costs	28,080	27,688	27,701	27,740	27,803	27,887	27,990	28,110
Gross margin	17,948	10,298	12,808	14,746	18,314	22,198	27,461	33,036
SFP	31,675	31,400	31,125	31,125	31,125	31,125	31,125	31,125
Net margin ²	32,265	21,446	24,730	25,774	28,759	31,761	36,120	40,600
S 2								
Revenue exc. SFP	53,827	35,835	25,261	25,428	24,371	28,257	30,724	33,333
Variable costs	27,470	23,650	19,965	18,982	18,393	18,323	18,273	18,241
Gross margin	26,357	12,185	5,296	6,446	5,978	9,933	12,451	15,093
SFP	31,675	31,400	31,125	31,125	31,125	31,125	31,125	31,125
Net margin	40,674	21,987	16,760	18,305	17,450	21,183	22,759	24,736
S 3								
Revenue exc. SFP	50,861	55,389	49,608	63,864	66,124	72,178	80,368	89,061
Variable costs	28,982	36,387	37,918	40,933	42,533	42,834	43,149	43,467
Gross margin	21,879	19,002	11,690	22,931	23,591	29,345	37,220	45,594
SFP	31,675	31,400	31,125	31,125	31,125	31,125	31,125	31,125
Net margin	31,358	25,458	18,872	30,174	28,671	38,894	44,711	51,789
S 4								
Revenue exc. SFP	50,861	55,388	49,605	63,860	66,119	72,172	80,361	89,053
Variable costs	30,124	37,510	39,027	41,840	43,394	43,652	43,926	44,206
Gross margin	20,736	17,878	10,579	22,020	22,725	28,520	36,435	44,847
SFP	31,675	31,400	31,125	31,125	31,125	31,125	31,125	31,125
Net margin	27,881	22,723	16,021	27,532	26,030	36,286	42,129	49,232
S 5								
Revenue exc. SFP	50,861	55,389	49,606	63,862	66,122	72,175	80,365	89,057
Variable costs	29,326	36,726	38,258	41,197	42,783	43,071	43,374	43,681
Gross margin	21,535	18,663	11,348	22,666	23,339	29,104	36,990	45,375
SFP	31,675	31,400	31,125	31,125	31,125	31,125	31,125	31,125
Net margin	29,954	24,320	17,676	29,050	27,534	37,756	43,570	50,644

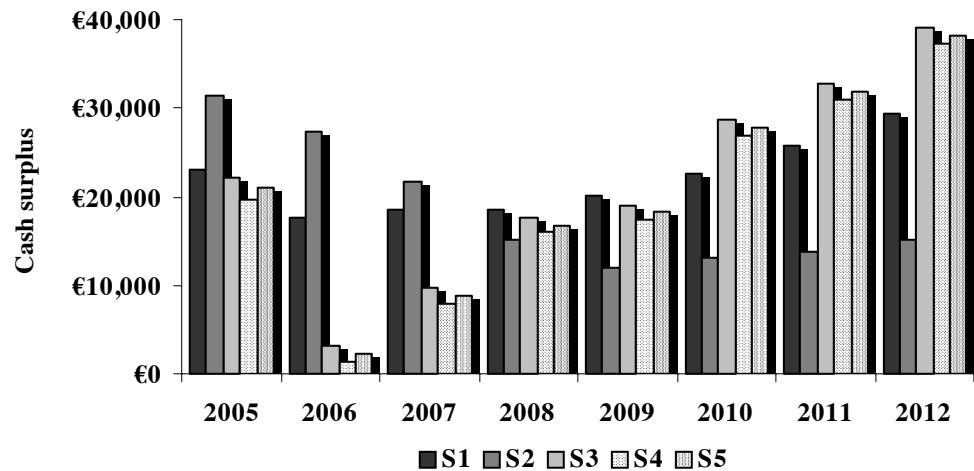
¹SFP = Single Farm Payment²Net margin = gross margin - overheads.

also the potential financial rewards. S2 initially has the highest farm margin of almost €40,700 in 2005 due to income from de-stocking sales. This margin quickly drops as animal sales in subsequent years drop sharply. In contrast, S3, S4 and S5 have low margins initially, particularly in 2007 but subsequently margins increase sharply with an increase in animal sales and beef price to between €49,200 for S4 and €51,800 for S3 in 2012. As expected, of the three expansion scenarios, S3 achieves higher margins followed by S5 with S4 the lowest of the three. S1 has higher net margins than S3, S4 and S5 in 2005 and 2007, however in all other years the expansion scenarios have greater margins.

In 2008 net margin is increased for the expansion scenarios due to a decrease in tax payable. This decrease is a result of a considerable reduction in net margin in 2007.

Family farms must also take into account cash surpluses or deficits when evaluating different systems of production. This cash flow position takes into account drawings from the farm business for family living expenses. The cash surpluses/deficits are presented in Figure 2. For S2, large cash surpluses in 2005 due to de-stocking sales are largely mitigated against by much reduced

Figure 2. Cash surplus



surpluses from 2007 to 2012. Surpluses range from approximately €31,500 in 2005 to over €15,000 in 2012. In contrast, the expansion scenarios have very low surpluses during the initial period of expansion to 2007. In 2006 in particular, cash surpluses are low although from 2008 surpluses rise sharply and are approximately €38,000 in 2012 for the three expansion scenarios. In contrast, there is a relatively moderate change in cash flow between 2005 and 2012 for S1 with surpluses in 2005 of approximately €23,000 and dropping to €17,500 in 2006 before rising to almost €29,500 in 2012.

Discounted farm net margin and returns on investments (ROI) are presented in Table 6. Discounted net margin represents the net present value of

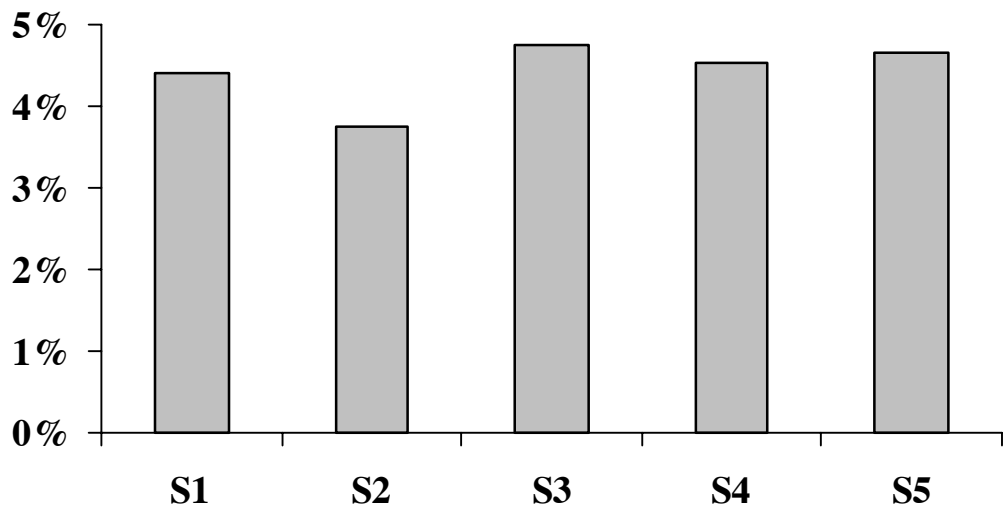
Table 6: Total discounted farm net margin and return on investment (all values in €)

Scenario	Discounted net margin	Return on investment
S1	201,735	
S2	158,139	
S3	223,017	0.24
S4	204,108	0.04
S5	214,982	0.15

future farm margins using a 5% discount rate. The expansion scenarios have the greatest discounted net margin with S3 in particular over €20,000 greater than S1. S2 has the lowest discounted net margin being almost €44,000 less than S1. The return on investments is presented for the expansion scenarios S3 to S5 and is the average additional annual profit earned relative to S1 for each additional Euro invested in herd expansion, building development costs and working capital. The greatest ROI is for S3 which has an ROI of 0.24. This represents a reasonable ROI given that it indicates the cost of investment can be repaid in approximately four years. The ROI for S4 and S5 are 0.04 and 0.15 respectively.

In measuring the rate of growth of a business, change in net worth is a useful indicator. Figure 3 illustrates the average annual change in net worth for the scenarios investigated. The change in net worth is similar for the three expansion scenarios at over 4.5% with the greatest average annual increase for S3 which increases by an average of greater than 4.7% per year. For S1 the average growth is 4.4% whereas the lowest growth is for S2 at 3.8%. The relatively modest differences between scenarios can be attributed to the large proportion of net worth attributable to the value of land which does not change between scenarios.

Figure 3. Average annual change in net worth.



Discussion

Agricultural producers are facing an uncertain future in Ireland due to changes in the CAP brought about by the LA of 2003 allied to fluctuations in world agricultural commodity prices. Beef producers are particularly vulnerable. Most producers are heavily dependent on premia receipts to maintain farm profits and prior to 2005 this led to farmers adapting their systems to maximise premia receipts rather than market returns. In many cases

premia receipts were greater than farm profits. From January 2005 farmers will not be required to maintain stock numbers to receive these payments and production systems will require a market based margin to justify their existence. The predicted reduction in beef price caused by increases in beef sales immediately following the implementation of LA further exacerbates the difficulties facing farmers going into this period.

In this paper, three development and expansion options open to beef farmers are examined in addition to one scenario where de-stocking occurs and a scenario where the farmer opts to retain the status quo. In general the financial results indicate a difficult period of adjustment for suckler beef farmers from 2005 to 2012. S1 may be used as a benchmark since in this scenario the production system does not change. Results indicate decreasing farm margins for S1 up to 2008. Following 2008, the increase in beef price results in improvements in profitability. By 2012 the net margin is 126% of the net margin in 2005. Cash flow follows a similar trend indicating that there should be little difficulty meeting cash expenses in this scenario.

It has been suggested that farmers may partially or fully de-stock following implementation of LA since the requirement to stock animals for the purposes of collecting premia no longer exists. S2 represents a partial de-stocking scenario. Whilst margins in 2012 are the lowest of the five scenarios, this may remain a potentially attractive option on some farms given the reduced labour requirements. Within the model there exists the possibility to rent out land although a compounding factor of LA is the requirement to retain land ownership to receive the SFP. However, farmers may rent out or afforest up to 50% of their land and “stack” the remaining entitlements on the remaining land area farmed. These provisions are not provided for in the Grange Beef Model, although it could reasonably be assumed that such options would be attractive to farmers particularly in the case of S2 where animal numbers and hence intensity of production is much less than the other scenarios investigated.

The high costs associated with the expansion scenarios result in low margins in 2006 and 2007. Although the margins for these scenarios recover to approximately €50,000 in 2012, it is unlikely farmers would accept the net margins and cash balances in 2006 and 2007, although the marked advantage over S1 from 2010 to 2012 may prove decisive. Cash flow issues become apparent in 2006, although cash flow recovers well from 2010 to 2012. It is likely that as some farmers de-stock, opportunities will arise for other farmers wishing to expand to source suckler cows at a lower cost than the cost of replacement heifers used in this paper. Alternatively, farmers may elect to expand at a slower rate than that used in the scenarios investigated in this study, using replacements sourced from within their own herd.

Closer investigation of S4 and S5 indicates that the type of capital development has a modest impact on the overall financial performance of the enterprise. Overall, there is little difference between the three scenarios on an annual basis. By spreading the costs of herd expansion and capital development over five and ten years respectively, the annual repayments on these investments are reduced. In addition, the greater initial cost for the slatted-floor shed in S4 is largely mitigated against by much lower operational

costs relative to the out-wintering pad considered in S5. However, the accumulated difference between the scenarios as presented in Table 6 illustrates a considerable advantage in favour of S3 and also in terms of the type of development, a considerable advantage in favour of S5.

In terms of all scenarios investigated, discounted net margin results indicate that the expansion scenarios are the preferred options, with farm net margins in the latter years of the time horizon modelled in particular indicating that, in terms of profitability in the longer term, expansion may be desirable. In addition to providing greater net margins in these years, the return on investment for S3 and S5 is favourable compared to typical investments such as deposit interest, property investments or equity investments. For the purposes of comparison in this study, no grant aid was assumed. The provision of grant aid would improve the attractiveness of these scenarios to farmers.

In general, financial results indicate that premia receipts will continue to constitute a considerable proportion of, and in some cases be greater than, farm net margin. Since these payments are payable regardless of whether the farm is engaged in active production, subject to complying with cross compliance requirements, farmers will need to generate “worthwhile” gross margins to justify production. Whether the gross margin is worthwhile is a matter for individual farmers, depending on factors such as opportunity costs of land, labour and capital. A compounding factor in Ireland has been the traditional attachment to land ownership which has resulted in many farmers taking up off-farm employment and continuing to farm part-time to combat falling farm profits rather than selling the farm business. Many beef farmers have off-farm employment with over 60% of total beef farmers reported to have off-farm employment in 2003 (Connolly et al., 2004). It is possible that some of the remaining full-time farmers may also opt for this scenario and take up off-farm employment. This is particularly the case where a successor has been identified. This off-farm employment may provide a vital cushion to enable farmers to sustain their activities through adverse conditions. However, many farmers have destocked and rented or sold their farms with the total number of farms declining by 20% between 1994 and 2004 (Department of Agriculture and Food, 2004). This trend is predicted to continue following implementation of LA (Binfield et al., 2003).

Conclusions

Results indicate that farmers will face a difficult period as the effects of implementation of the LA materialize. Farmers may adopt a “wait and see” approach whilst other farmers may chose to contract production. Farmers who elect to de-stock must be aware of its long term effects as they will be unable to capture the full effects of beef price increases predicted, particularly post 2007. Despite this, reduced labour requirements and the resulting opportunity to take up off-farm employment may make this alternative attractive to many farmers. Farmers who wish to expand should identify the associated costs and carefully prepare budgets to measure the impact of expansion. Results presented here indicate that expansion may result in difficult cash flow and net margin situations in the years immediately following investment. Farmers should be aware that drawings from the farm business may become more

severely limited than the level of drawings modelled here during the period of expansion but that if this period can be endured future benefits may be substantial. Afforestation and/or renting out land may be an attractive option given the stacking provisions of the LA and increased possibilities to participate in off farm employment.

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REFEREED PAPER

COMPARISON OF RISK IN ORGANIC, INTEGRATED AND CONVENTIONAL CROPPING SYSTEMS IN EASTERN NORWAY

Gudbrand Lien, Ola Flaten, Audun Korsæth, Keith D. Schumann, James W. Richardson, Ragnar Eltun and J. Brian Hardaker

The aim of this study was to compare risk of organic, integrated and conventional cropping systems. Experimental cropping system data (1991-1999) from eastern Norway were combined with farm budget data. Empirical distributions of net farm income for different cropping systems were estimated with a simulation model. The results show that the organic system had the greatest net farm income variability, but both the existing payment system and organic price premiums make it the most economically viable alternative.

Key words: Risk analysis, crop farming, cropping systems, stochastic simulation, risk aversion, stochastic efficiency with respect to a function

Introduction

There is general agreement that sustainable agriculture refers to the use of resources to produce food and fibre in such a way that the natural resource base is not damaged, and the basic needs of producers and consumers can be met over a long term. Sustainable agriculture entails ecological, social and economic aspects (Yunlong and Smit, 1994). The choice of cropping system is an important issue as different systems have different environmental, agronomic and economic consequences.

Comparing different cropping systems requires a systems or whole-farm approach (not a partial analysis) because factors interact. A cropping systems project with the aim of allowing comparison of different cropping systems was initiated in 1989 at Apelsvoll Research Centre in eastern Norway. Eltun *et al.* (2002) compared environmental, soil fertility, yield and economic effects between the cropping systems. However, the economic analysis ignored the effects of risk on the selection of cropping systems.

There are reasons to believe that different cropping systems perform differently given the same weather conditions and thus have different impacts on income risk for a farm. For example, restrictions on pesticide and fertiliser use may give rise to different production risk in organic farming than in conventional farming. Additionally, smaller organic markets may mean greater price fluctuations.

These types of risks should be considered when comparing economic viability between cropping systems, because most farmers are risk-averse, and there is a need to account for downside risk (Hardaker *et al.*, 2004a). Yet most economic studies comparing cropping systems look exclusively at expected profitability measured by average net farm income (Roberts and Swinton, 1996). However, expected profitability is an insufficient criterion as it ignores likely differences in the riskiness of net income between cropping systems.

One way to assess and compare profit (in)stability is by using stochastic simulation. Mahoney *et al.* (2004), Smith *et al.* (2004), and Ribera *et al.* (2004) all used stochastic simulation to apply a stochastic dominance framework on experimental data to analyse income risk differences between

arable crop systems in the United States, while Langyintuo *et al.* (2005) have done a similar study of rice farming in Ghana.

We expand on the procedure used by Ribera *et al.* (2004). Our goal is to compare the distributions of returns between conventional, integrated and organic cropping systems in eastern Norway, and to quantify the importance of specific organic area payments and price premiums on economic viability. The Apelsvoll experimental cropping data are supplemented with farm budget data.

Materials

It is hard to find relevant and reliable data to compare differences in the distributions of returns between cropping systems. One option is to use non-experimental farm-level panel data, i.e., repeated observations over time on the same farms. There are two main problems with non-experimental farm-level panel data for comparing risk between cropping systems: 1) sufficient data for two or more farming systems on the same farm grown over the same years are very difficult (if not impossible) to find; 2) unless sufficient data from a single farm are available, comparative data from different farms would include noise, such as different climate, soil and growing conditions, disease and weed stress, topology conditions, and farm management practice, that have little to do with differences in risk between the cropping systems.

An alternative to farm-level panel data is to use yield data from verified scientific experiments of cropping system treatments. Then most of the problems mentioned in point 2 above can be avoided. The problems with using experimental data are: 1) usually few observations; 2) that farm practices and results from experimental conditions may differ from what is obtained on real farms; and 3) data are often only from one site (usually an experiment station).

This last point reduces the scope to generalise the results. However, some general implications may be drawn from such information, since it is the differences in risky outcomes between cropping systems which are the focus of this study. Moreover, for our study, the experimental practice and yields were quite close to what is typical for crop farms in eastern Norway. Our approach to deal with the problem of sparse data is discussed in the "Method" section.

Stochastic variables

Most of the stochastic yield variables were based on the experimental cropping data from Apelsvoll Research Centre. The field experiment started in 1989 but, because it takes some time to get a system established, the data used in this study are based on the results for 1991-1999. The period 1991-1999 was fairly representative of the normal annual variation in growing conditions at the site.

Three cropping systems are included in our data set: CON – conventional crop production without manure as a fertiliser supplement; INT – integrated crop production without manure; and ORG – organic crop production with manure as a fertiliser. Each cropping system in the experiment was studied on two model farms, each of 0.18 ha. Each model farm had eight rotation plots

and an eight-year crop rotation. All of the crops in each rotation were grown each year. For commercial non-organic crop operations in Norway somewhat simpler rotations are more commonly used. Table 1 summarizes the main characteristics of the cropping systems. The experimental design, management of individual cropping systems and soil conditions on the model farms are described in more detail in Eltun *et al.* (2002).

Table 1. Characteristics of the cropping systems at Apelsvoll Research Centre, Eastern Norway 1991-1999.

	Cropping system ^a		
	Conventional (CON)	Integrated (INT)	Organic (ORG)
Management			
Crop rotation	Barley ^b	Barley ^b	Barley ^c
	Winter wheat ^d	Winter wheat ^d	Annual grass-clover
	Oats	Oats	Spring wheat ^c
	Barley	Barley	Potatoes
	Potatoes	Potatoes	Barley ^c
	Spring wheat	Spring wheat	Annual grass-clover
	Oats	Oats	Winter wheat ^{d, e}
	Barley	Barley	Oats ^c
Fertiliser	Yes	Yes ^f	No
Slurry	No	No	Yes
Soil tillage	Spring ploughing ^g	Spring harrowing	Spring ploughing
Crop protection	Chemical	Integrated ^h	Mechanical

^a The proportion of cropland is equally devoted to each of the eight crops for each of the three rotation systems.

^b Early potatoes in the period 1991-1994.

^c With undersown crop (timothy, red clover and alsike clover).

^d For CON and INT spring wheat in the period 1998-1999. For ORG spring wheat in 1994-1995 and 1998-1999.

^e With undersown crop (annual ryegrass and white clover).

^f Less use of mineral fertilisers compared to the CON system.

^g Autumn ploughing in the period 1991-1994.

^h Less use of pesticides compared to the CON system, mechanical weed control in potatoes.

Inspection of the experimental data permitted the combination of some of the crops within a rotation (varieties of the same crops) without significantly reducing the information from the experiment. The consolidation resulted in six crops in the CON and INT systems and seven crops in the ORG system. Table 2 shows the descriptive yield statistics and elicited expert judgements (prepared by a group of crop researchers related to the experiment) about probable minimum and maximum yield levels for the individual crops in the three cropping systems.

Compared to the CON system, the average yields were lower for all individual crops in the INT system, and lowest in the ORG system with 60-65% of the conventional yield. Nitrogen supply is the major factor limiting plant growth in organic cropping systems in Norway (Haraldsen *et al.*, 2000),

Table 2. Descriptive yield statistics and subjective judgements (prepared by an expert group of crop researchers) of minimum and maximum yields for the individual crops in the cropping systems, 1991-1999.

Cropping system	Barley I ^c (kg ha ⁻¹)	Barley II ^c (kg ha ⁻¹)	Oats ^d (kg ha ⁻¹)	Potato (kg ha ⁻¹)	Spring wheat (kg ha ⁻¹)	Winter wheat (kg ha ⁻¹)	Grass-clover (kg DM ha ⁻¹)
Conventional							
Mean	5018	5665	5394	30 839	5903	5867	
CV ^a	27.8	15.9	16.4	23.3	15.9	26.0	
Minimum, o ^b	2718	4053	3812	19 500	4290	4229	
Maximum, o	6871	7124	6897	42 650	7224	8171	
Minimum, s ^b	1600	1600	1800	15 000	1800	1800	
Maximum, s	8700	8700	8600	49 000	8600	9000	
Integrated							
Mean	4496	4908	4816	27 749	4943	5299	
CV	30.1	19.1	21.9	21.4	10.9	25.5	
Minimum, o	2800	3915	2718	22 310	4150	4053	
Maximum, o	6212	6506	6159	40 910	5982	7565	
Minimum, s	1600	1600	1800	15 000	1800	1800	
Maximum, s	7100	7100	7000	47 000	6800	8300	
Organic^e							
Mean	3165	3823	3415	21 103	3422	3734	8939
CV	43.3	35.3	44.1	43.6	18.0	16.1	22.7
Minimum, o	1320	1320	0	7100	2120	3012	6309
Maximum, o	5329	6306	4900	36 670	4194	4471	11 774
Minimum, s	0	0	0	0	0	0	3000
Maximum, s	6900	6900	5400	42 500	4600	4900	13 000

^a CV = coefficient of variation, defined as standard deviation divided on mean yield.

^b o = observed value from the experiment, s = subjective extreme values given by an expert group.

^c Barley I and Barley II represent two different varieties of barley.

^d For CON and INT the two oats experiment results (same varieties) were combined in one variable (cf. Table 1).

^e In the ORG system barley and oats are under-sown (c.f. Table 1). This will be associated with some yield penalty compared with growing them as single crops, and may cause more yield variation compared to the CON and INT systems.

and thus may be the primary cause for lower yields. In Europe, arable crop yields in organic systems are typically 60-80% of those under conventional management (Stockdale *et al.*, 2001; Mäder *et al.*, 2002), while studies from North America have reported smaller yield reductions for organic relative to conventional systems (Stockdale *et al.*, 2001; Mahoney *et al.*, 2004). In the Rodale experiments in Pennsylvania, crop yields under normal rainfall were similar in the organic and conventional systems, whereas the organic system produced higher corn yields under drought conditions (Pimentel *et al.*, 2005).

The relative variability in yields, expressed by the coefficient of variation (CV), was generally highest for ORG, second highest for INT, and smallest for the CON cropping system. However, for potatoes and spring wheat production, the INT rotation system showed the smallest relative variation, while for winter wheat the ORG system showed the smallest CV.

The agricultural policy in Norway is implemented in annual state budgets and in annual negotiations between the two farmers' unions and the

government on financial support to agriculture. Financial support is provided through import tariffs and via a set of budgetary payments (area payments in crop farming). In the agricultural agreement target prices (maximum average prices) are set for most commodities (NILF, 2003: 5-30). The potato price has been quite unpredictable, and was stochastically modelled¹. Deflated (to 2004-money value) historical potato prices in NOK (Norwegian kroner) per kg for 1991-1999 from the Agricultural Price Reporting Office (LP, 2000) were used to specify the empirical potato price distribution. Based on organic potato price premiums in Norway 2003/2004 and price premiums for organic potatoes in other European countries (Offermann and Nieberg, 2000), organic potatoes were assumed to be sold at prices 50% above conventional prices, and with the same relative variability (hence higher absolute variability).

The general level of grain prices has been set annually and can be regarded as non-stochastic in Norway. However, variability in quality parameters such as Hagberg falling number (a measure of starch quality determining whether the grain achieves bread-making quality) and protein content cause some unpredictability in the wheat farm-gate price. These quality parameters were recorded in the experiment and this information was used to model stochastic wheat prices. Table 3 shows the descriptive product price statistics for wheat and potatoes. For all crop products, prices at harvesting were used to account for the value of production and thus to calculate net returns of the particular cropping system. Given the purpose of this study, the whole-farm analysis was not extended to analyse alternative storage and marketing strategies.

Table 3. Descriptive product price statistics (for CON and INT systems) and product price estimates (for ORG system) in NOK (£1 ≈ NOK 11.8) kg⁻¹ for spring wheat, winter wheat and potatoes. Year 2004 price level.

Cropping system	Potatoes	Spring wheat	Winter wheat
<u>Conventional</u>			
Mean	1.66	2.04	1.97
CV ^a	21.10	8.82	9.25
Minimum	1.18	1.56	1.56
Maximum	2.19	2.10	2.05
<u>Integrated</u>			
Mean	1.66	1.97	1.97
CV	21.10	11.94	9.25
Minimum	1.18	1.56	1.56
Maximum	2.19	2.10	2.05
<u>Organic</u>			
Mean	2.49	3.18	2.92
CV	21.10	5.15	7.47
Minimum	1.77	2.76	2.76
Maximum	3.29	3.30	3.17

^a CV = coefficient of variation.

1. Potatoes are less storable than grain, and yield variation between years causes high price variability.

Deterministic variables

The farm in this study was constructed to have 40 ha of arable land, a typical crop farm size in the region. The farms with CON and INT cropping systems were assumed to grow 15 ha barley, 10 ha oats, 5 ha spring wheat, 5 ha winter wheat, and 5 ha potatoes. The ORG crop systems consisted of 10 ha barley, 5 ha oats, 5 ha spring wheat, 5 ha winter wheat, 5 ha potatoes, and 10 ha annual grass-clover (for silage). These crops mix proportions are the same as were used in the experiment (Table 1).

Table 4. Deterministic product prices in NOK kg⁻¹, and area payments and variable costs (VC) in NOK ha⁻¹ for each individual crop and cropping system. Year 2004 price level.

Cropping system	Barley I	Barley II	Oats	Potatoes	Spring wheat	Winter wheat	Grass clover
<u>Conventional</u>							
Product price ^a	1.64	1.64	1.41	1.66 ^b	2.04 ^b	1.97 ^b	
Area payment	3300	3300	3300	2500	3300	3300	
Seeds	782	871	752	4850	1083	950	
Fertilisers	1023	1023	986	2470	1509	1602	
Pesticides	819	729	509	1819	1168	1235	
Machinery ^c	3142	3142	3142	14 071	3247	3247	
Others ^d	295	295	295	3295	295	295	
Sum VC	6061	6061	5684	26 505	7302	7329	
<u>Integrated</u>							
Product price ^a	1.64	1.64	1.41	1.66 ^b	1.97 ^b	1.97 ^b	
Area payment	3300	3300	3300	2500	3300	3300	
Seeds	782	871	752	4850	1083	950	
Fertilisers	744	744	744	1581	905	1046	
Pesticides	379	69	69	632	619	619	
Machinery ^c	2249	2249	2249	15 202	2606	2606	
Others ^d	295	295	295	3295	295	295	
Sum VC	4449	4229	4109	25 560	5508	5516	
<u>Organic</u>							
Product price ^a	2.79	2.79	2.36	2.49 ^b	3.18 ^b	2.92 ^b	1.43 ^f
Area payment ^e	5800	5800	5800	5000	5800	5800	3540
Seeds	2399	2399	2052	5850	2624	2420	1335
Manure	500	500	500	1000	500	500	
Machinery ^c	3128	3128	3296	16 365	3296	3128	2296
Others ^d	295	295	295	3295	295	295	295
Sum VC	6322	6322	6143	26 510	6715	6343	3926

^a Product prices net of yield-dependent haulage cost for grain and potatoes and silage making costs for annual grass-clover.

^b Stochastic variables are specified in Table 3.

^c Cost of all machinery operations.

^d The expected value of the stochastic specified irrigation cost is included here, in addition to miscellaneous cost in potato production.

^e Included the specific organic area payments of NOK 2500 ha⁻¹ for grains and potatoes and NOK 550 ha⁻¹ for grasslands.

^f Product price for annual grass-clover is in NOK (kg DM)⁻¹.

The price of silage made from grass-clover was treated as deterministic, as were input prices and prevailing area payment schemes (2004/2005). These deterministic data, which were taken from NILF (2004a), are shown in Table 4.

Inputs per hectare of seed, fertiliser/manure, pesticides, and machinery operations were assumed to be identical to those used in the experiment. The costs of machinery operations, reflecting prevailing rental costs in the market, exclusive of operator labour, were based on typical mechanisation for 40 ha farms. European studies show labour use in organic crop farming to be 10–20% higher than comparable conventional systems (Offermann and Nieberg, 2000). Labour use does vary from farm to farm depending on the degree of mechanisation, marketing strategies, the enterprise portfolio, etc. The additional labour requirement in ORG was assumed to be 15% more than the 2000 hours of labour for CON. The INT system was assumed to use 20 hours less labour per year than CON because of the less labour intensive tillage system. The farm's total fixed costs for the INT system was estimated at NOK 160 000, based on the Norwegian farm accounting survey (NILF, 2004b). The extra labour cost for CON resulted in fixed costs of NOK 162 684, and for the ORG system the total was NOK 205 284.

Scenarios analyses

The model was used to analyse three scenarios. First, given the prevailing payment system and organic price premiums, the three cropping systems CON, INT, and ORG were compared.

To encourage crop farmers to convert to and continue organic farming practices, the Norwegian government introduced area payments for producing organic field crops in the mid 1990s. It has been demonstrated that some farmers consider the organic area payment as risky and they fear this payment will decrease (Koesling *et al.*, 2004). In scenario two, therefore, the area payment for organic farming is removed. The ORG producers are assumed to receive the same area payments as CON and INT producers.

The price premium may decrease with increased supply of organic product as more farmers convert to organic production. Hence, in scenario three, both the organic payments and the organic price premiums are removed. Scenario three illustrates the economic viability of the ORG system without any price premiums or organic support payments. For this last scenario, input prices for organic seeds are reduced almost to the prices of conventional seeds.

Method

A stochastic simulation model for the hypothetical farm is used to estimate an empirical probability distribution for annual net farm income ($\tilde{I}$). The annual net farm income is a function of area, yield, prices, area payments and costs. More formally, the model used to simulate the three alternative cropping systems can be described as

$$\text{where} \quad \tilde{I} = \sum_{j=1}^k \left[A_j (\tilde{Y}_j \times \tilde{P}_j + AP_j - C_j) \right] - FC$$

A_j	is the area in hectares of crop j in the cropping system;
$\sum_{j=1}^k A_j$	is then total farm land area;
$\tilde{Y}_j$	is the per-hectare stochastic yield of crop;
$\tilde{P}_j$	is the per-kg stochastic or deterministic price for crop;
AP_j	is the per-hectare area payment for crop;
C_j	is the per-hectare deterministic variable cost for crop;
FC	is the fixed costs.

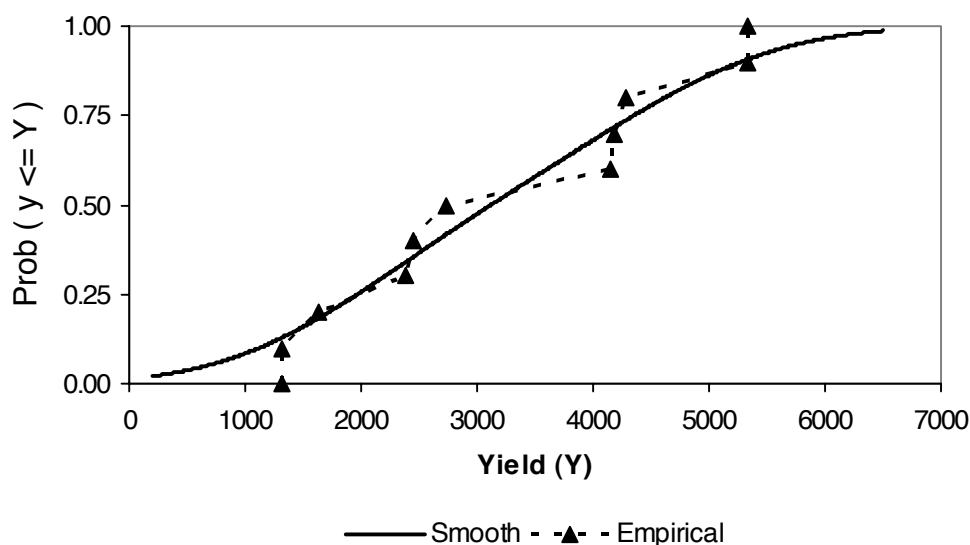
The experimental sample yield data consisted of nine annual observations. In simulation, sample data can be used to estimate the parameters for a parametric distribution (such as the normal). With sparse data, assumptions of parametric probability distributions can be problematic due to the lack of power of tests of those assumptions and the inability of the small sample to reflect the true parameters. An alternative is to let the “data speak” by using the empirical distribution. However, empirical distributions do not allow one to simulate beyond the range of observed data, which could bias the results if indeed values could extend beyond the observed minimum or maximum. This problem is especially relevant when the data are sparse, as in this case.

A better option when using sparse data is to apply a smoothing method to the empirical distribution estimation. Irregularities in an empirical distribution are often a result of sampling error or an unaccounted for structural influence. It is usually reasonable, therefore, to assume that the population follows a smooth distribution, implying that the irregularities should be adjusted in fitting a distribution (Anderson, 1974). Moreover, supplementary information that can make modelling the sparse data more reliable should be considered when smoothing. For example, the upper and lower bounds of a true underlying continuous distribution would often be more extreme than those observed from a sparse data set. Judgements from experts can be used to estimate such bounds. Figure 1 illustrates the empirical and a smoothed cumulative distribution function² (CDF) of organic barley yields in the Apelsvoll experiment. The experimental barley yield distribution was smoothed using a Gaussian kernel density function³ with the addition of minimum and maximum values specified by a panel of experts. Silverman (1986) suggested the use of a kernel density function estimator (KDE) to

2. A cumulative distribution function gives the probability that a stochastic variable is less than or equal to a specific value (Hardaker *et al.*, 2004a). In the remainder of this paper, CDF will be used to indicate the sample CDF estimated from data.

3. The kernel density approach is a formalisation of the free-hand approach to sketching in a curve to fit an empirical cumulative distribution: the basic idea is that one slides a weighting window along the yield/price scale, and the estimate of the density depends on the kernel of the assumed probability distribution. The smoothed estimate is a result of the individual observations that are weighted relative to the position of the window. See Silverman (1986: 13-19) for a technical description of the approach.

Figure 1. Empirical and smoothed cumulative distribution functions (CDFs) for organic barley yield per ha.



smooth sparse data for a probability distribution. In this paper, the empirical distributions for prices and yields were smoothed using a KDE approach. The stochastic yields and prices for the crops were simulated using a more general version of the multivariate empirical (MVE) distribution estimation⁴ described by Richardson *et al.* (2000) which allows one to simulate the distributions as multivariate KDEs. The multivariate KDE procedure takes into account the stochastic dependency between the random variables when sampling in the simulation model (Richardson, 2004).

Risk analysis requires both probabilities and preferences for outcomes held by the farmer. The subjective expected utility hypothesis (SEU) states that a rational person will seek to make risky choices consistently with what they believe, as measured by their subjective probabilities, and with what they prefer, as evaluated via their utility functions for consequences. The shape of the utility function reflects a person's attitude towards risk. Several attempts have been made to elicit such utility functions from farmers to put the SEU hypothesis to work in the analysis of risky alternatives for agriculture. Usually the results have been rather unconvincing. Partly to avoid the need to elicit a specific single-valued utility function, methods under the heading of stochastic efficiency criteria have been developed (Hardaker *et al.*, 2004a).

In this study we apply a method, called stochastic efficiency with respect to a function (SERF) (Hardaker *et al.*, 2004b) to compare the simulated empirical probability distributions of annual net farm income for the three cropping systems. The SERF method ranks risky alternatives, such as net incomes for alternative crop mixes, over a range of risk aversion levels. The ranking is made using sample certainty equivalents (CEs)⁵ at each possible risk aversion level. As a result, the method allows one to show which risky

4. A multivariate distribution consists of two or more stochastic dependent variables.

alternative is preferred by decision makers who, e.g., are slightly risk-averse, moderately risk-averse, or highly risk-averse. Some technical details about the application of the SERF method and the assessed range of risk aversion used in this study are given in the Appendix.

The simulation model used was programmed in Excel and simulated using the Excel Add-In Simetar© (Richardson, 2004). The SERF analysis of the simulated incomes for the alternative cropping systems was conducted using Simetar.

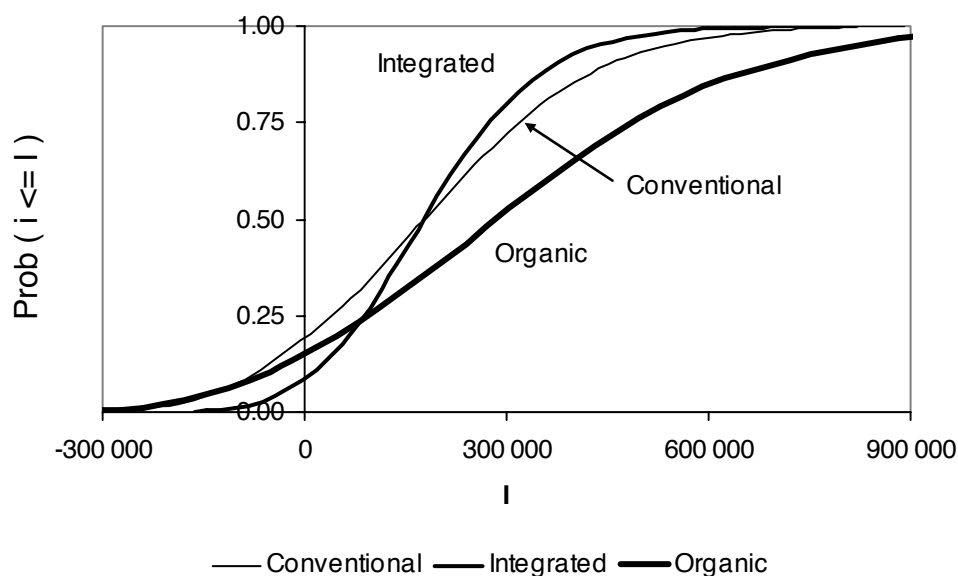
Results and discussion

Existing Norwegian price and public payment system

Results of simulating the three crop systems under the existing payment system and organic price premiums in Norway are presented as CDFs of annual net farm income in Figure 2.

Three observations can be drawn from Figure 2. First, the ORG system in general shows a higher net farm income than the CON and INT systems.

Figure 2. Simulated CDFs of annual net farm income (I) in NOK under conventional (CON), integrated (INT), and organic (ORG) cropping systems. Farm size 40 ha.



Second, the net income from the ORG system can be described as the one with the most uncertain income, as the CDF for ORG is less steep than the CDFs for CON and INT. Moreover, the ORG CDF has a lower minimum and a larger maximum than either of the other CDFs. The relative uncertainty for

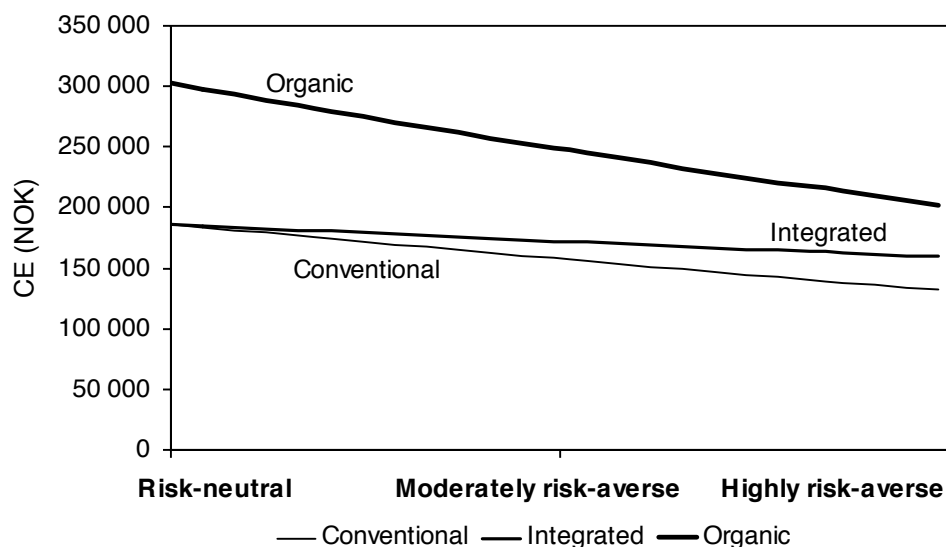
5. Certainty equivalent is defined as the sure sum with the same utility as the expected utility of a risky alternative (Hardaker *et al.*, 2004a).

yields is generally highest for the ORG system (Table 2). In addition, the high yield uncertainty combined with the organic price premium has a multiplicative effect on the uncertainty of net farm income for the ORG farming system.⁶ Third, under the existing payment schemes, all of the crop systems show some probability of generating negative net farm income. For example, the CON system is associated with an 18% chance of experiencing a negative annual net farm income, while the corresponding chance is about 14% for the ORG system.

The expected annual net farm income for the simulated ORG system is NOK 302 000, for INT NOK 186 000, and for CON NOK 186 000. In other words, the CON and INT systems were found to have the same expected income. Crop yields were higher under the high input CON strategy, but were offset by cost savings for the INT system because of lower costs for tillage, fertiliser, and pesticides. Comparison of CDFs for the CON and INT crop systems shows that they have a slightly different risk profile, where the INT system has the lowest uncertainty. The alternative cropping system a farmer would prefer depends on his/her degree of risk aversion.

A SERF analysis of the three risky alternative cropping systems is summarised in Figure 3. At all risk aversion levels from risk-neutral to highly risk-averse, farmers would prefer the ORG farming system over the INT and CON systems. A risk-neutral farmer would rank the CON and INT cropping systems equally. The INT cropping system would be slightly more preferred than the CON system for farmers with some degree of risk aversion, because

Figure 3. Certainty equivalent (CE) curves for annual net farm income in NOK for the conventional (CON), integrated (INT) and organic (ORG) simulated crop systems.



6. One referee correctly questioned the strong assumption that the organic potato price is expressed in a fixed ratio to the conventional price. A more flexible specification of the organic potato price was tested (uniformly distributed between 30 and 70% above conventional prices and the organic potato price independent of the other stochastic variables). The test results were very similar to the results obtained under the fixed ratio assumption.

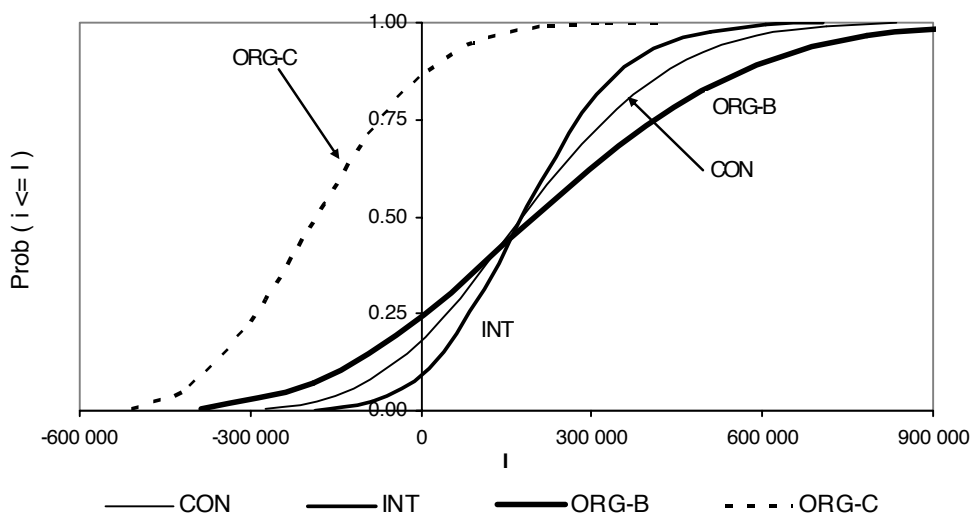
INT has higher CEs than the CON for all degrees of risk aversion.

These findings can be compared with results of similar studies elsewhere. With organic price premiums included, North American field tests have also indicated higher economic returns for organic than for conventional cropping systems (e.g., Mahoney *et al.*, 2004; Smith *et al.*, 2004; Pimentel *et al.*, 2005). Smith *et al.* (2004) found slightly higher risk in the organic rotations, Mahoney *et al.* (2004) did not find returns in the organic strategies to be more variable than the conventional ones, while Pimentel *et al.* (2005) reported more variable returns in the conventional rotation.

Effects of removing organic area payments

The preceding results may be sensitive to changes in the payment system. If the area payments for organic farming are removed, ORG producers receive the same area payments as CON and INT producers. This policy change would alter the net farm income distribution for ORG (Figure 4).

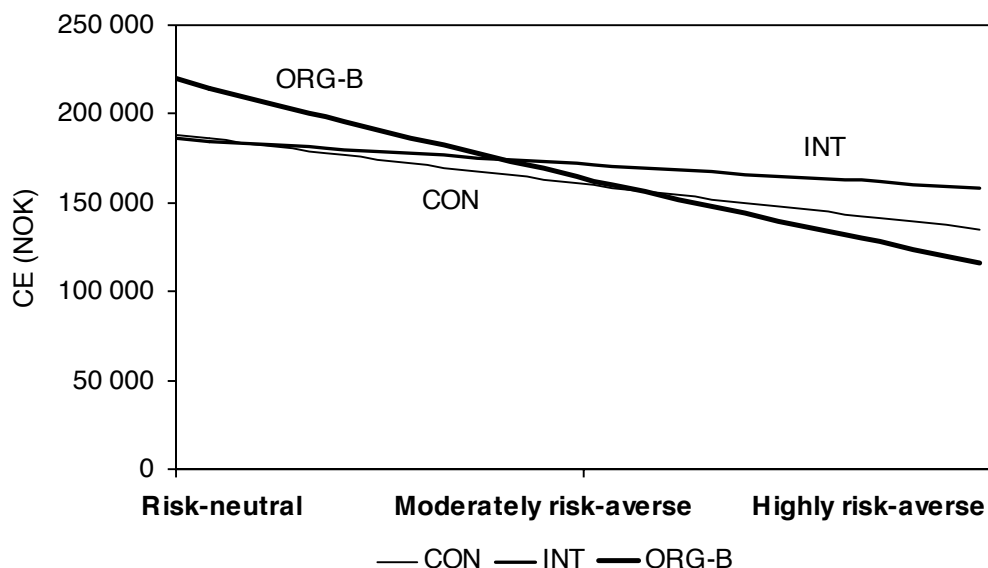
Figure 4. CDFs of annual net farm income (I) if organic area payments are removed for the simulated ORG system (ORG-B) and if organic area payments and price premia are removed for that system (ORG-C).



Comparing Figure 4 with Figure 2, the expected negative shift in the CDF of annual net farm income for the ORG system if organic area payments are removed (ORG-B) can be seen. The expected annual net farm income for ORG drops from NOK 302 000 with organic area payments to NOK 220 000. Figure 5 shows the SERF ranking of the three cropping systems for different degrees of risk aversion under the no ORG area payments scenario (ORG-B). Under these circumstances, the ORG-B system is the most preferred for farmers with low to about moderate risk aversion and the INT system is preferred for farmers with moderate to high risk aversion.

It is possible to determine how large the organic area payment must be,

Figure 5. Scenario with no area payments for organic farming. CEs for annual net farm income in NOK for the CON, INT and ORG-B (without organic area payments) cropping systems.



under prevailing market prices, to make the ORG system as preferred as the CON or INT system for farmers with a given range or attitude toward risk. As an example, a highly risk-averse CON farmer who is offered an annual additional payment of NOK 19 000 (for example as organic area payment) would consider the economic viability of ORG production equal to that of the CON system.

Effects of removing organic area payments and organic price premiums

Comparing the dotted CDF in Figure 4 with the bold CDF in Figure 2 illustrates a dramatic negative shift in the CDF of annual net farm income of the ORG system if the organic area payments are removed and also the organic price premiums erode (ORG-C). At any level of risk aversion, the CON and INT production systems are preferred to the ORG-C farming system. The expected annual net farm income for ORG drops to a loss of NOK 176 000 for the scenario without organic support payments and price premiums. Figure 4 shows an 87% chance that the ORG-C system will generate a negative annual net farm income.

In comparison with these results, North American studies without organic price premiums have reported equal (Mahoney *et al.*, 2004) or lower (Smith *et al.*, 2004; Pimentel *et al.*, 2005) economic returns in organic than in conventional crop rotations. However, these studies did not show a dependency on price premiums and/or area payments for organic cropping to be a viable option, to conventional crops.

Conclusions

The results show that the organic cropping system currently stands out as the most economically viable alternative and the most preferred alternative for risk-averse producers, even though annual net farm income is more uncertain. Without area payments for organic farming and organic price premiums, the other two cropping systems would be preferred by all farmers, regardless of degree of risk aversion.

Although the results are site specific for eastern Norway, the differences in performance between cropping systems may not be very different on other sites with similar environmental conditions.

Given the above findings of the current attractiveness of organic cropping, it is somewhat surprising that only 1.7% of the area of grain and potatoes crops in Norway was under organic management in 2004. Several factors can explain the current low proportion of organic crop production. First, the relative variability in yields between years is highest for the organic system. Second, many farmers fear that the existing organic payment and organic price premiums will decrease (Koesling *et al.*, 2004), so they are fearful that conversion to organic production will not be worthwhile. Third, since farmers (as others) have a tendency to assign lower variance to the system they know than to unknown systems, the conventional farmers may subjectively assess the risks of converting as higher than our experimental data imply. Fourth, operations without livestock may have to rely on a complete legume-based organic cropping system instead of using manure as a nitrogen source. Additional labour is required in organic systems. Finally, some farmers are "committed conventional", completely rejecting the organic farming philosophy.

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Appendix

In SERF, to compute the CEs, we start by picking a particular form for the utility function for transitory income (in this study the negative exponential utility function). Transitory income is the good or bad income in any one year which is assumed to have little or no effect on the probability distribution of income in subsequent years (Friedman, 1957). Utility can then be calculated using the chosen utility function depending on the farmer's degree of risk aversion and the distribution of the transitory income. The distribution of the transitory income is the output from the simulation procedure. The calculated utility value is then converted to the certainty equivalent income for ease of interpretation.

The range of risk aversion to be used in the SERF analysis is crucial. The farmer's relative risk aversion with respect to wealth is the appropriate one for prescriptive analysis. It is important to get consistency between relative risk aversion with respect to wealth, $r_r(W)$ and absolute risk aversion with respect to transitory income, $r_a(I)$. By defining W as deterministic wealth and I as uncertain transitory income we have the following relationships $r_a(I) = r_r(W)/W$. A realistic relative risk aversion coefficient with respect to wealth, $r_r(W)$ is within the bounds 0.5 to 4. In other words, we need to divide $r_r(W)$ by W for $r_r(W)$ in the range from 0.5 to 4 to obtain the approximately corresponding range expressed in $r_a(I)$. The typical level of a farmer's wealth, W , is assumed to be NOK 1 350 000. Then, a value of $r_a(I)$ in the range 0 (risk-neutral) to 0.000003 (highly risk-averse) corresponds to a $r_r(W)$ in the range 0 to 4. This range was used as the risk aversion bounds in this analysis.

A more thorough treatment of SERF, how to consistently assess risk aversion coefficients across payoff measures, and other relevant references can be found in Hardaker *et al.* (2004a).

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CONFERENCE PAPER

**COLLABORATIVE SUPPLY CHAIN INVESTMENT: AN
IMPERATIVE FOR BRITISH FARMING?**

*Siôn Roberts*¹

This paper reviews the contribution farmer controlled businesses (FCB) currently make and could make to the future prosperity of farm businesses in the UK. It argues that the expansion of FCBs in the UK will allow farmers to secure markets for their products and capture the increasing value of food. This will need farmers to radically change their investment policy: to move away from on-farm investment towards off-farm investment into agricultural supply chains.

(Key words: collaboration, co-operation, farming, partnership, food).

Introduction

To satisfy shareholders' expectations for returns on capital in an extremely competitive business environment there is no food retailer in the UK that is not intent on controlling costs in their supply chain. For food processors this means doing whatever it takes, year in and year out, to keep a lid on the price of raw materials. Increasingly this has meant sourcing from abroad. For British farmers, key suppliers of many of those raw materials, this poses a significant problem. As the weakest player within the supply chain they have increasingly found themselves squeezed from both sides as they face lower prices for their outputs while being unable to significantly cut the cost of their inputs.

The response until now, encouraged by government, has been to continually search for efficiency savings at the farm level. Britain leads the way in Europe in achieving economies of scale with an average farm size significantly above the EU average. Yet income per farmer still fell by 53% between 1995 and 2003 in the UK while it rose in the EU as a whole by 17% (Eurostat 2005; Defra 2003).

This has led to significant pressure on the British farming industry. The overall volume of agricultural output having increased by over 30% in the previous two decades fell in the late 1990s and continues to decline. Imports of agricultural and food products have increased sharply. The food trade deficit has almost doubled to over £10bn. Moreover, farm and trade policy changes are set to increase the level of international competition in the UK food market yet further. The 2005 reform of the Common Agricultural Policy (CAP) will lead to both a decoupling and a reduction in the level of production subsidies to farmers. At the same time enlargement of the EU and the on-going WTO negotiations will lead to greater competition from imports.

Reduced subsidy combined with continued pressure on farm gate prices mean that farm incomes are set to remain under considerable pressure. There is a very real likelihood that, post 2005, many more farmers will be forced to leave the industry, that overall agricultural production will continue to fall and that imports of food will continue to rise. As in the past, to maintain

1. This paper was presented at a Cranfield conference on the 19th November 2004.

profitability, individual farmers will continue to expand their volume of production both to capture economies of scale and to maintain overall farm profitability. By itself, however, this strategy is no longer enough. Efficiency gains alone are not the answer.

In addition, farmers will be increasingly compelled to develop market and supply chain-orientated strategies to increase their returns. Crucially, this may involve a radical change in investment policy; a move away from on-farm investment and a shift to greater off-farm investment and into agricultural and food supply chains.

This investment may be financial but may also be an investment in building long term, interdependent horizontal and vertical collaborative relationships within the farming and food industry. Such investment will not yield an immediate return. Rather the aim must be long term and strategic, to secure a market for British produce and to strengthen long term farming profitability.

The need for radical change

The key issue for farming, and its suppliers and customers in the food chain is to recognise that the attitudes and business practices that served in an era of protection and price support are unlikely to be appropriate in the future. The future will be characterised by intense competition but also new opportunities.

A key milestone in the development of the industry was the signing of the GATT Uruguay Round, bringing agriculture under international trade umbrella for the first time. Trade barriers have since been gradually reduced and competition from abroad has increased. The current round of the WTO looks likely to lead to yet further trade liberalisation and the enlargement of the EU in May 2004 has also brought additional competition onto British agricultural markets. UK and European farmers now have to compete with producers from across the globe. Trying to compete on price alone is proving an increasingly difficult task. International costs of milk production (Table 1) illustrate the point. Costs of milk production in Chile, Argentina, New Zealand and Russia are less than half of those in the EU.

Table 1. Cost of milk production.

Rank	Country	US Cents/KG
1	Chile	7.7
2	Argentina	8.5
3	New Zealand	13.5
4	Russia	14.0
5	Australia	16.0
6	Poland	17.1
7	India	18.9
8	China	19.9
9	USA	26.7
10	EU	28.9

Source: Fonterra (undated).

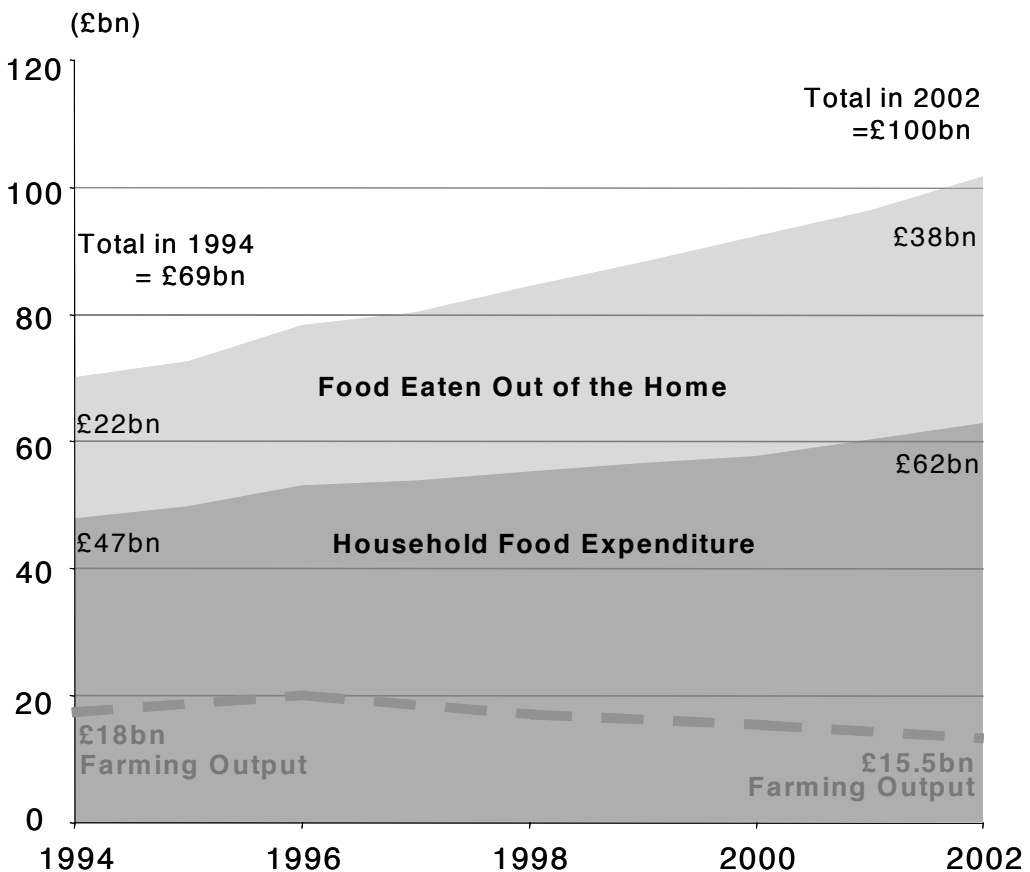
Advances in technology and managerial knowledge will continue to drive the food and farming industry towards increasing concentration of production. But in an increasingly deregulated agricultural world market, a new approach is needed to secure a profitable future for British farmers.

Capturing the increasing value of food

The UK farming industry is part of a supply chain leading to a huge and growing market. This provides opportunities to those willing and capable of creating and capturing value within it. If British farmers don't take that opportunity, someone else will.

Through the 1990s the total value of expenditure on food in the UK rose by more than 50 per cent to £100bn in 2002. The main driver of this trend is an increase in the value of what people are eating rather than an increase in the volume. The increase in value is being driven in two ways: more prepared foods are being consumed, both in and out of the home, which are more expensive than buying basic commodity products and demand for higher quality foods is increasing along with consumers' willingness to pay a premium for these products.

Figure 1. The UK Food Market



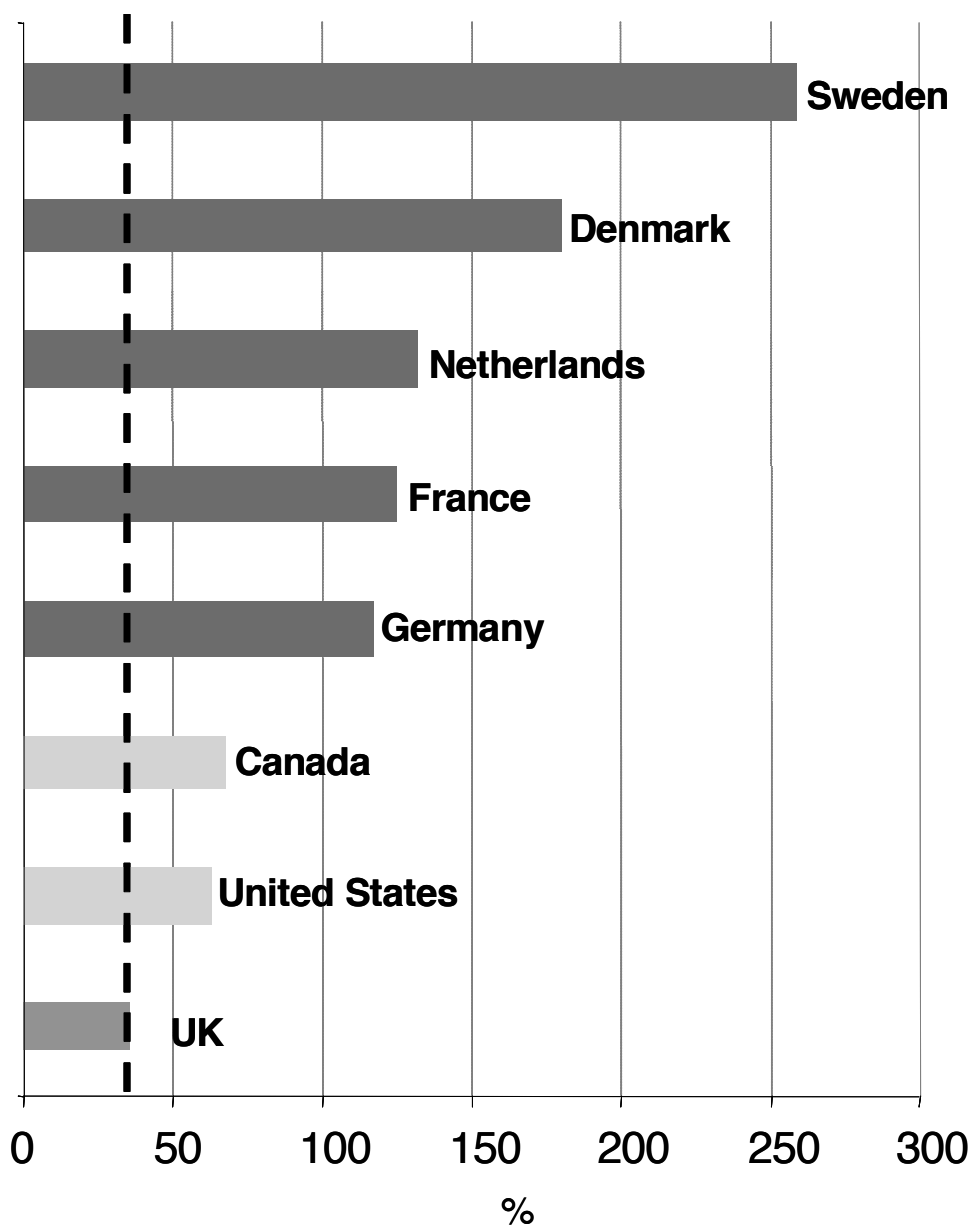
The consumer demands which are driving these changes and which show no signs of altering are a combination of lifestyle, demographic and economic trends. When applied to the food market these trends particularly reflect the demand for convenience, the desire to eat more healthily or purchase organic,

local or regional products and the pursuit of new exotic tastes.

Yet the growth in the value of the food market has not been reflected in a rising value of farming output which was at very much the same level at the end of the 1990s as it was at the start. Value growth is benefiting the food retailers and processors, in particular those who operate in added value or prepared food categories, but there has been little 'trickle down effect' to farm level. Farmers are failing to capture any of the increasing value of food.

Processors have been able to create new and differentiated products to respond to supermarket (and consumer) demands whilst farmers, by and large,

Figure 2. FCB turnover compared to agricultural output.



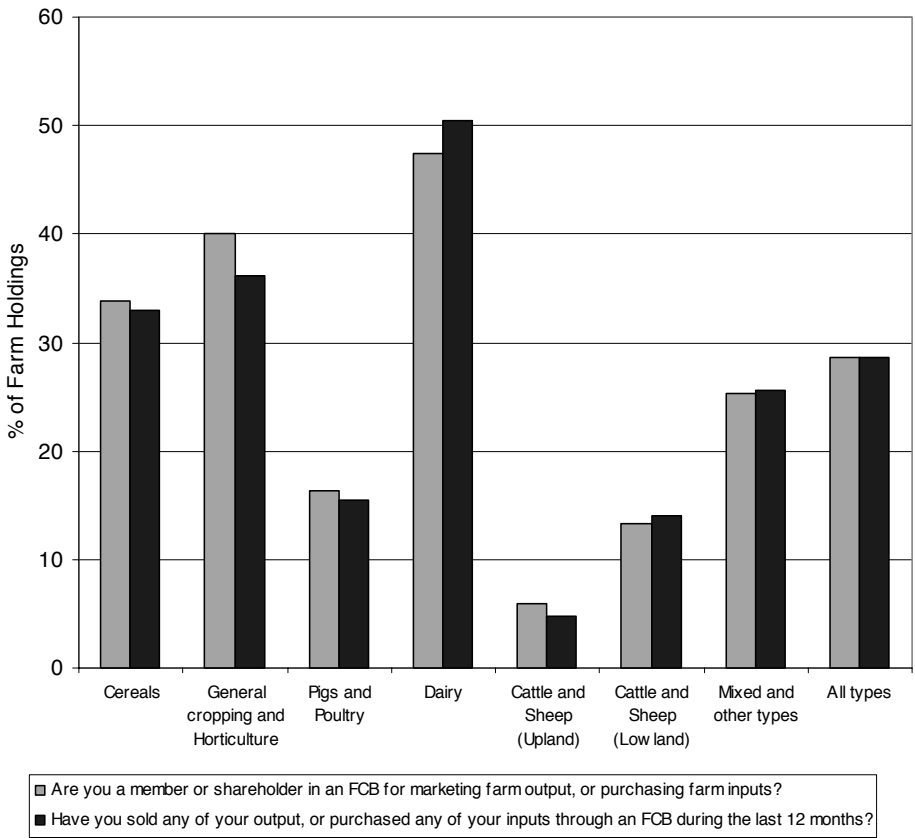
have continued to produce a commodity output from a fragmented production base. Moreover, rationalisation within the processing and retail sectors has further weakened the strategic position of farmers within the food chain.

Investing in the supply chain

While the UK stands out in Europe for having large efficient farms, it also stands out for having a very small and fragmented farmer controlled business (FCB) sector. The farming industry in England is behind the game in collaborative investment. For a range of historical reasons – including our previous trading relationships, differing support structures and land laws and a political focus on the consumer – collaboration among farmers has not developed here to the extent that it has in Europe and North America. In these countries farmers have built up large FCBs and through them now have significant off-farm investments in their food supply chains (Figure 2). As in any business sector there is a range of performance among international FCBs. But the value being created and captured by them for farmers is huge and in many cases is still growing.

Despite the development of some very innovative collaborative initiatives in England and a handful of very good FCBs, at the aggregate level we are still a long way behind (Figure 3).

Figure 3. Membership of UK FCBs.

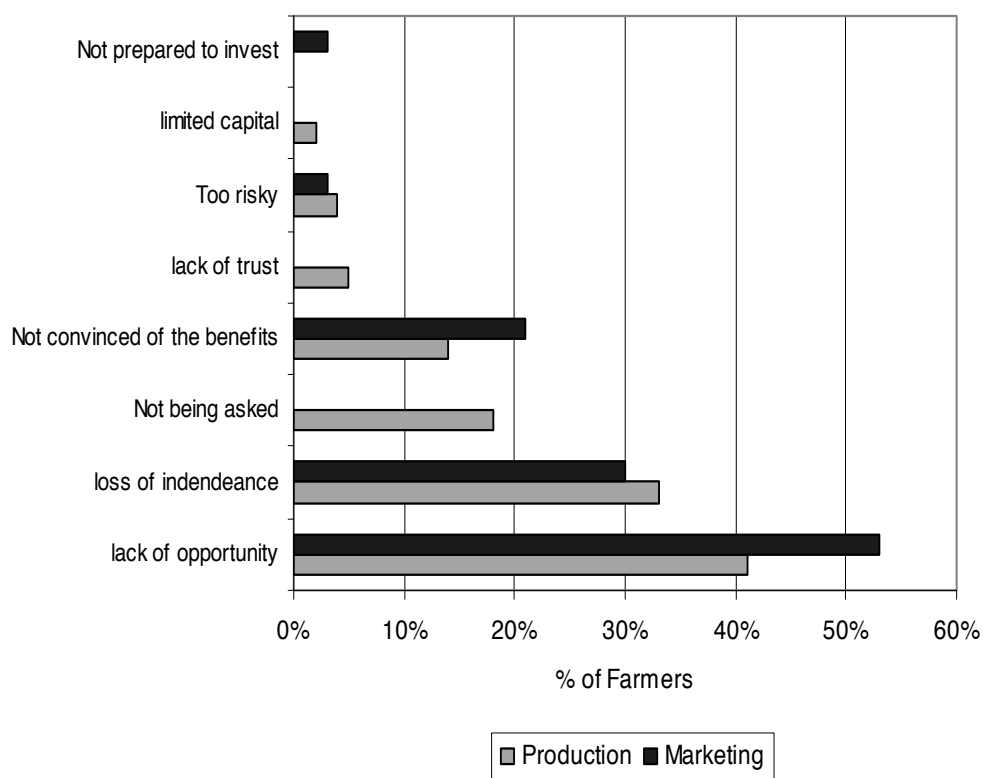


Total FCB output in England - at some £3.5-4.0bn - is equivalent to 30-35 % of gross agricultural output of around £11.5bn. In Denmark and Sweden FCB output is around double that of their agricultural industries. This indicates the level of value that is being added by their FCBs through processing and service delivery – ultimately to the benefit of their farmer members. There are a number of FCBs around the world such as Danish Crown, Arla and Fonterra whose individual turnovers are all greater than the entire FCB sector in England.

Collaborative activity also varies considerably between different farming sectors in the UK. In a recent Defra survey around 50% of dairy farmers said they were a member of an FCB and had traded with it in the last twelve months. Some 30-40% of arable and horticultural producers did the same and around 25% of pig producers. But only 5% of upland beef and sheep producers were involved with an FCB – and around 12% of lowland ones.

Interestingly when English farmers were asked why they didn't collaborate more the answer was not because they didn't have enough capital or that they thought it too risky and weren't prepared to invest. Rather they said they lacked opportunity, were not convinced of the benefits and were concerned about the loss of independence (Figure 4).

Figure 4. Why farmers don't collaborate more.



Development of international FCBs

While the development of FCBs abroad has taken place over many years it would be a mistake to think that the development of all the biggest and best FCBs took place decades ago. Key developments in many international FCBs have taken place in the last ten years as they have reacted to the changing needs of farmers and to the changing market environment. In New Zealand, for example, the UK's accession to EEC in 1973 threatened the traditional markets it had enjoyed for butter and their market diversification drive became urgent. In 1987 the passing of Dairy Board Act made the New Zealand Dairy Board financially independent of Government and in 1992 domestic milk and dairy products markets were deregulated.

In 1994 the GATT Uruguay Round was finally signed, bringing agriculture under international trade umbrella for the first time. In response, New Zealand dairy FCBs consolidated down from 12 to 4, with the argument for mergers being increasingly strategic. In 1999 a pan-dairy industry strategic plan was agreed. A three-fold revenue increase in 10 years was the target. In 2000 the New Zealand farming industry chose one single mega company as the best structural option to implement its strategic plan and farmers voted to form a new company - later named the Fonterra Co-operative Group.

Fonterra is co-operatively owned by more than 12,000 dairy farmers. It is one of the top ten dairy companies in the world and is the leading world exporter of dairy products and is responsible for a third of international dairy trade. New Zealand dairy farmers have long been renowned for producing quality milk more efficiently than anyone else in the world. Today New Zealand is a world leader in large-scale milk procurement and processing too. Fonterra's global supply chain stretches from farms in New Zealand to customers and consumers in 140 countries, with some of the best known dairy brands, world leading manufacturing sites, quality and cost marketing and distribution with seamless integration from cow to customer.

A remarkable change in just 25 years and the development continues apace. In Australia, Fonterra is already one of the largest dairy companies with dairy manufacturing, domestic sales and export operations throughout the country. Fonterra's Australian businesses generate more than A\$1.4 billion per annum in turnover and its brands account for 14 per cent of dairy sales in Australia. Within the last couple of months Fonterra has announced that it intends to takeover National Foods Limited, Australia's largest publicly listed dairy company – not for short term gain but to strengthen their long term strategic position within the marketplace.

The returns from investment

The clear commitment of New Zealand farmers to collaborative investment is easily demonstrated. In total the dairy farming members of Fonterra have invested NZ\$38bn in the dairy industry. NZ\$27bn in land and herds and NZ\$11bn in Fonterra. Nor is that investment small, opportunistic or short term. Each farming member, on average, has NZ\$2.2m invested in their farms and close to NZ\$0.5m invested in their FCB.

The benefit to those farmers of their off-farm investment is clear and measurable. They have secured and are growing a market for their product.

They are building a share in a leading global dairy company and the value added by that company is passed back to them in the form of annual distribution. In 2003/4 their final payout was NZ\$4.25 per kg of milk solids, amounting to a distribution of NZ\$5.1bn to farmer members. Of that NZ\$576m came from value added earnings, up 7% on the previous year.

FCB development in North America

In America too, there are equally inspirational examples. The American Crystal Sugar Company is a world-class agricultural co-operative specialising in the production of sugar and related agri-products. It is owned by approximately 3,000 shareholders that produce sugar beet from a total of 500,000 acres in Minnesota and North Dakota. Existing as a corporation until the early 1970s, the company was bought by the sugar beet producers and converted to a co-operative and is now the largest sugar beet producer in the United States. American Crystal utilises innovative farming practices, low-cost production methods and sales and marketing leadership to produce about 15% of America's highest quality sugar.

Dakota Growers Pasta Company began as a co-operative with the aim of adding value to durum wheat. Continued growth over the past 10 years has seen the company develop into the United States' third largest producer of dry pasta. The success of the co-operative, and the need to maintain its market position through further investment, led to the decision to transform Dakota Growers Pasta Company to a corporation in July 2002 demonstrating that no one single financial or legal structure is appropriate in every situation.

Innovation has allowed a cranberry growers' co-operative to become a leading producer in juice drinks. By continually developing new products, Ocean Spray has remained successful in a very competitive market. Today the co-operative is the best selling brand name in the canned and bottled category in North America. The industry has been struggling in recent years, but Ocean Spray's new product White Cranberry juice has helped to rebuild the market and consumer interest in cranberries.

These are just a few examples but they demonstrate what can be achieved and the value that can be both created and captured by farmers working and investing together collaboratively.

FCB development in Europe

Within the EU a wide range of performance exists within the FCB sector but the leading FCBs are becoming major multinational businesses. A process of mergers and acquisitions within some member states in the 1990s is moving on to a process of international mergers and acquisitions in the current decade.

For example, in Denmark, the first co-operative pig slaughterhouse was established in the town of Horsens in 1887. During the following 40 or 50 years a large number of pig slaughterhouses were established around the country. In 1960 the co-operative slaughterhouses began to merge in order to acquire more strength to handle functions such as sale, marketing, and product development. In 1998 Danish Crown and Vestjyske Slagterier merged. Most recently Danish Crown and Steff-Houlberg merged, and a large proportion of the original co-operative pig slaughterhouses are now included in the new

Danish Crown.

A number of private slaughterhouses have been purchased or shut down over the years, and today the Danish co-operative pig slaughterhouses slaughter and sell approximately 94% of the Danish pig production. Danish Crown slaughters 90% of that volume and has a turnover of over €5bn. In 2004, Danish Crown combined their UK subsidiary Tulip with Flagship Foods to create Tulip Ltd. The group has sales of close to £1bn and employs 7000 people across 21 sites making it the second largest meat processor in the UK.

The largest FCB sector in Europe is undoubtedly the dairy sector with a total turnover of some €35bn (Table 2). Nearly one quarter of total dairy FCB turnover is through Dutch FCBs, Friesland Coberco and Campina. Germany comes next with 18.1% of total turnover and Denmark/Sweden third with 15.6%. In 2002/3 less than 4% was through UK dairy FCBs although their turnover has increased rapidly in the last two years as they have invested in milk processing capacity

Table 2. Top-20 Country Ranking - Share of Dairy FCB Turnover (2003).

Country ranking	Country	% Top-20 Turnover share
1	Netherlands	23.4%
2	Germany	18.1%
3	Denmark/Sweden	15.6%
4	France	10.8%
5	Ireland	8.4%
6	Norway	4.5%
7	Finland	4.5%
8	UK 02/03	3.8%
9	Switzerland	3.4%
10	Italy	2.1%
11	Spain	1.9%
12	Portugal	1.9%
13	Belgium	1.6%
	Total	100.0%
	<i>€m</i>	35,123

Source: NICE (2005).

In the EU dairy sector the national merger process has led to a series of huge, multinational, FCBs (Table 3). The largest of the EU dairy FCBs, Arla Foods was formed in a cross-border merger between Sweden and Denmark and has a turnover of nearly €5.5bn. With its acquisition of Express Dairies in 2003, Arla became the largest milk processor in the UK. Half of all Arla Food's turnover is now outside their home market of Denmark and Sweden. In 2001/2 Arla Foods, in addition to paying an increased milk price to its Danish and Swedish farmers, made a profit of DKK 1.16bn or nearly £110m.

Table 3. Top 20 European Dairy FCBs

Rank 2003	Company	Country	2003 Turnover (€m)
1	Arla Foods*	Den/Sweden	5,469
2	Friesland Coberco	Netherlands	4,575
3	Campina	Neth/Germ/Belg	3,655
4	Sodiaal***	France	2,823
5	Humana	Germany	2,681
6	Nordmilch	Germany	2,140
7	Glanbia	Ireland	2,041
8	Tine	Norway	1,587
9	Valio	Finland	1,566
10	Emmi	Switzerland	1,205
11	3A	France	980
12	Dairygold	Ireland	914
13	Hochwald	Germany	789
14	Bayernland	Germany	758
15	Granarolo	Italy	731
16	First Milk**	UK	703
17	Capsa	Spain	674
18	Lactogal	Portugal	661
19	DFoB**	UK	617
20	Milk Link**	UK	581

Book year ending September except for ** book year ending March and *** Only half of 50%-daughter Yoplait is included - its book year 2003 ended June.

Note: exchange rates DKK, NOK, CHF and GBP to EUR at book closure date

Source: NICE (undated)

As with Fonterra, a supplementary payment is made to its farmer members in addition to the milk price to reflect the profit made from their off-farm investment within dairy processing. Danish and Swedish farmers are seeing returns from both their on-farm and their off-farm investments.

FCB development in England

While no FCBs of anywhere near this magnitude exists in England (except perhaps, it could be argued, the NFU Mutual) there are recent signs that the FCB sector is starting to both restructure and grow. In the last few years the dairy sector has restructured significantly and three FCBs have emerged (Table 4). In the last six months all three have made or stated their intention to make significant investments in the UK dairy supply chain. Milk Link has purchased a 75% stake in the Cheese Company, DFoB has purchased ACC and First Milk is in the process of taking a 15% stake in Wiseman's Dairies.

These are very encouraging signs although they are likely to be only the first stage in the development of these FCBs as they transform themselves from milk broking businesses into major farmer owned dairy processing businesses. At the same time a different approach is being tested by dairy producers supplying into Arla. They are collaborating horizontally through the Arla Milk Partnership and have invested in the supply chain by buying shares in Arla UK. They are also collaborating vertically with a new long term deal to supply liquid milk to Asda.

In the cereal sector the market share of FCBs has increased significantly with one FCB, Grainfarmers, now having a market share of around 20%. Moreover both Grainfarmers and Centaur Grain have been developing closer

Table 4. Top 20 English FCBs.

Rank	Company	Sector	Turnover (£m)
1	First Milk	Milk	£300+
2	DFoB	Milk	£300+
3	Milk Link	Milk	£300+
4	Grainfarmers	Grain	£300+
5	Centaur	Grain	£100<£300m
6	G's Marketing	Hort	£100<£300m
7	KG Fuits	Hort	£100<£300m
8	World Wide	Hort	£100<£300m
9	Mole Valley	Supply	£100<£300m
10	Countrywide	Supply	£100<£300m
11	Meadow Quality	Livestock	£50<£100m
12	Cornwall Farmers	Supply	£50<£100m
13	Wynnstay	Supply	£50<£100m
14	Thames Valley Cambac	Pigs	£50<£100m
15	United Oilseeds Producers	Oilseeds	£50<£100m
16	Anglia Farmers	Supply	£50<£100m
17	Branston	Potatoes	£20<£50m
18	Framlingham	Supply	£20<£50m
19	Woldmarsh	Supply	£20<£50m
20	Farmway	Supply	£20<£50m

Source: EFPF (undated).

links with their customers. Centaur led the way with the development of a close relationship with Warburtons bakery. They have followed this with deals with both Coors and Bernard Matthews. More recently, Grainfarmers have agreed a long term, one million tonne deal with Rank Hovis.

Horticulture has a longer history of collaboration than the main supported agricultural sectors. Some of the FCBs here such as KG Fruit, Worldwide and G's Growers are extremely successful. Others that have failed to adjust to the changing market situation have been less so.

The livestock industry has the smallest FCB sector. In the pig sector FCBs have a market share of about 25% but in beef and sheep it is more like 5-10%. Five FCBs operate in pigs but the FCBs in the beef and sheep sector remain very small and fragmented. Significant change will be needed here if FCBs are to create and capture real value for livestock producers.

Rationalisation and growth is also being seen in the supply sector. Two types of supply FCBs exist. First, multipurpose ones which supply farm inputs but which have also developed significant rural retailing operations the largest of which is Mole Valley. Second, more focussed buying groups many of which are very small although some larger ones are developing e.g. Anglia, Framlingham and Woldmarsh.

Finally, a number of service FCBs exist including grain storage as well as machinery and labour sharing FCBs. Some are very successful such as Camgrain and 7Y Rural Services. Many others are doing less well.

Mergers and acquisitions

Key trends within the British farming and food industry are creating conditions that tend to put smaller less professional FCBs under pressure.

- As farms get larger and fewer in number individual farmer members

become more critical and relationships and services offered become more important than ever.

- At the same time consolidation in both the FCB and non-FCB sectors means that competition is increasing.
- Customers and suppliers are getting larger and more sophisticated, limiting both choice and bargaining power for FCBs.

In short, the consolidation of agri-business and the industrialisation of agriculture is driving change. Increasingly the reason for merger and acquisition activity may be for strategic reasons – not for short term cost savings but to enable the development of bigger and more professional FCBs capable of securing markets and delivering value to their farmer members over the longer term.

Key success factors

As in all business sectors the performance of FCBs varies widely and there are inevitably some business failures. In England a handful of FCB failures have tended to receive a lot of attention and this in turn has undermined farmers' confidence in FCBs. Rebuilding that confidence is a major challenge for the sector and a key challenge for English Food and Farming Partnership (EFFP).

A number of common factors stand out as being important in developing successful FCBs. These include that:

- The driving motivation must be profit, not co-operation for its own sake.
- Planning must be strategic and for the long term to deliver maximum benefit to farmer members.
- Total Member commitment and loyalty to the organisation is needed.
- The hiring of professional management and giving them space to manage is essential.
- Strict corporate governance must be adhered to, to ensure the integrity and proficiency of management; and
- Risks must be taken though investing in order to capture greater rewards from the supply chain.

Conclusions

Farmers tend to view the world from a different perspective than many businessmen. Farming is both a livelihood and a lifestyle. By its very nature, farming tends to be a long term business. Many on-farm investments such as the purchase of land or even stock can take years to deliver a return. Nevertheless farmers have made these investments because most are in

farming for the long term, measured for many in generations, not years.

The vision of building a substantial FCB sector in England, with the investment in time and money that it would involve is a bold one. But key changes underway in the economic environment surrounding farming mean that it may be essential. To secure markets for British farm products and to support farmers' incomes by enabling them to capture the increasing value of food, investment by farmers in the supply chain needs to increase and the UK FCB sector needs to grow and become truly world class. There is not a set way of doing that or any one single financial or legal business model. Collaborative investment can take many forms.

- Traditional FCBs need to re-design themselves to meet the demands of 21st century farmer members and customers. There is evidence that this process has begun although there is a long way to go.
- There needs to be rapid growth in a new generation of FCBs designed to create value for their members. This will take time, loyalty and investment from farmers and may also need innovative new forms of financing.
- We need the development of other new forms of producer collaboration – collaboration at farm level to cut costs and increase efficiency and alliances within the supply chain to both create and capture value and secure markets for British product.

With farm incomes under pressure, major new investments in the supply chain look daunting. But the agricultural industry's balance sheet is strong. Innovative new forms of financing may be needed to make available the funds for supply chain investment that is needed. Nor is the investment needed always financial. It may take several forms such as the time and determination needed to build long term collaborative partnerships. In general, however, investment involves taking a risk in return for the chance of a greater reward.

And is collaborative supply chain investment an imperative for British farming? Not all FCBs abroad are great businesses and not all of them return significant value to their farmer members. But farmers the world over are facing similar challenges and where they have managed to build world class FCBs they appear well positioned to secure and grow their markets and to both create and capture a greater share of the value of the food products that they produce. To do this, as with the example of New Zealand dairy farmers, many have built up significant off-farm investments.

Post 2005, as government pulls back from the management of agricultural markets in Europe, the challenge for British farming is to begin to think more strategically and to begin investing for the long term. This process will not be quick or easy. But that's the nature of farming. Crucially it may involve a radical change in investment policy; a move away from on-farm investment and a shift to greater off-farm investment and into agricultural supply chains. This would involve a wholesale change in mindset among the farming community, a greater appetite for risk and collaboration outside the core

farming business and the development of a significant and professionally run, FCB sector within the UK.

Activity during the course of 2004 suggests that the first steps are now being taken towards this goal. The challenge for British agriculture is to build on this promising start and to begin to invest seriously in the market. EFPF believes in this vision and is committed to playing its part in helping to deliver it. Ultimately, however, it will only come about if British farmers want it and are prepared to do whatever is necessary to make it happen.

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Biographical Notes

Siôn Roberts is the Chief Executive of English Food and Farming Partnership (EFPF). Formerly he was an independent consultant specialising in economic analysis of the food and farming industries. In 2001/02 he acted as the economic adviser to the Policy Commission on the Future of Farming and Food. Prior to this Siôn was Chief Economist at the NFU providing analysis and advice to senior management and Office Holders on major economic and strategic issues, he was also a member of the Agricultural Wages Board for five years. Siôn was previously a commodity trader in the city.

CONFERENCE REVIEW

REVIEW OF THE 15TH IFMA CONGRESS, BRAZIL.

Matthew Naylor

As the third generation on our family's intensive farming operation in South Lincolnshire, I have responsibility for the day-to-day management of the farm and contribute to its strategic development. It can be a challenge to balance the immediate demands of the business with the need to unearth new ideas and to develop these opportunities to secure our business's long-term success. The old adage about the third generation "one to make it, one to keep it, one to lose it" rings perpetually in my ear. And as my business supplies multiple retailers with short shelf-life products it can feel perilous to spend much time away from the farm. It is therefore with some excitement and not a little trepidation that I am embarking on a Nuffield scholarship. Having dedicated the greater part of my life to developing my business, I am almost bewildered by the possibilities that the scholarship presents. One of the chief annoyances with the learning process is the sudden realization of your own ignorance. I became quickly and painfully aware that I knew a great deal less about international agriculture than I had previously supposed. With this in mind, I attended the Fifteenth International Farm Management Association Congress, which was held in Brazil. This article presents my considered reflections on the conference and my personal viewpoint on the value of attendance to a working farm manager.

The International Farm Management Association is an association of people who are directly or indirectly involved in agriculture and who may be described as have a particular interest in agriculture in other parts of the world. This includes the whole spectrum of individual from corporate producers, to farm managers, to advisors, researchers, teachers, policy-makers and suppliers. The Association, which has members in over 50 countries, states its objective as "to further knowledge and to exchange ideas and information about farm management theory and practice throughout the world".

The Association holds a Congress every two years in a different country. In 2003 it was Perth Australia, before that Wageningen in the Netherlands. Each Congress is organized by members living in the host country. The themes alter but the aims of exchanging ideas and experience, learning about the structure of agriculture and marketing of the host country and stimulating contact between delegates at a national and international level remains unchanged. Representatives from such a range of countries make the Congress an ideal venue for developing a broader insight into international agriculture.

The 2005 Congress was held in Campinas in Brazil. Campinas is situated about 100 kilometres south of Sao Paulo in a very productive agricultural and horticultural area. The Congress lasted for six days, three of which allowed for presented papers and two for farm-visits. The theme of this Congress was "Developing Entrepreneurship Skills to Feed the World in a Sustainable Way". Brazil is an appropriate host for such a conference; it has become one of the most significant food producing countries in the world with its

enormous landmass coupled with an adequate supply of rain water. The Brazilians farmers are ambitious and their potential is a long way from being reached.

Over a hundred papers were presented at the Congress in the three days. To cover such a large number, parallel sessions are needed, with up to six papers being given in parallel on occasion, all of which demands good planning to be in the right place at the right time to listen to the papers of most interest. The subjects covered are hugely diverse, ranging from local to international, and all are (or soon will be) available on the IFMA website (www.ifma15.org).

The papers were all largely academic but gave me an insight into local difficulties in other countries, such as the maize surplus in South Africa or the challenge of attracting young people into horticulture in the Netherlands. Since most academic studies are based upon events and trends which have already occurred; there were no easy answers about the direction in which I should drive my business in the future. I should have liked to have seen a few papers from successful farmers and managers to combine the academic principles with practical reality.

The consensus amongst all the delegates was that entrepreneurship is the skill most needed to meet the world's growing demand for food. This capitalist view surprised me. My views diverged from some of the speakers as I still believe that entrepreneurship cannot be taught and should not be confused with risk-taking. Risk-taking is not a great characteristic in someone who is producing food.

It was fascinating to compare the attitude of different nationalities. I came away feeling I identified most strongly with the straight-forward commercial mentality of the New Zealanders. Without support payments, they have only their customer to consider. Their clear focus on the global marketplace should provide inspiration to UK farmers over the next decade.

The introductory presentations and field visits soon showed that agriculture plays a very important part in the Brazilian economy and their government takes it very seriously. At 530 billion rial (R\$) agriculture accounts for a massive 35% of Brazil's GDP. After many years of inflation, the currency was massively devalued in 1999 and although it is now gradually strengthening again, it remains fairly weak, an ideal result for the export led Brazilian agriculture sector. Coupled with a large investment in research and development, the growth of Brazilian agriculture has been meteoric - the area farmed has doubled since 1968 as have yields, resulting in a four fold increase in production. Farm profitability has increased by 50% in the last 10 years.

It would be a comfort to British growers if I could report that Brazilian production is inefficient or able to work to lower environmental standards but this is not the case. I visited a factory owned by the World's largest orange juice manufacturer, Cultrale, a site that produces a third of a million litres each day, with freezer capacity for 50,000 tonnes of concentrated juice. The site is powered by the waste from a nearby sugar cane plant and, although not new, it is kept spotlessly clean and managed highly efficiently, for example water is recycled and all waste is compressed into pellets and sold for stock feed.

My own particular interest is the ornamental sector. Brazil's largest cut flower producing region is called Holambra; which is Brazilian for "Holland in Brazil" – named by the Dutch who established the industry in the 1960s. It has its own version of the Dutch clock auction which handles about 35% of the flowers sold in Brazil. We visited a nursery which produced about 12,000 pots of lilies and cut flowers each week – all grown under low cost polythene tunnels and irrigated using 80% rainwater. The nursery employs 38 staff with an average wage of about £2,000 a year. The wholesale market in Campinas only started selling flowers in 1995 but now this trade is worth £100 million each year; it has over 500 different stands, 80% of which are producers selling their own plants and flowers.

We saw little in Brazil that I would call state of the art, but their low cost of production are perfectly geared to the demands of their customers. The use of natural resources was dramatically more efficient than I am used to seeing in the UK.

For me, the true value of the Congress was talking to the people I met. It is perhaps easy to recognise the difficulties we face in our own country but it can be far harder to identify our strengths. These are spotted much more easily by someone from a different country. Although UK farmers face a huge number of challenges, we have opportunities too. We have on our doorstep some of the wealthiest consumers in the world. This is why our foreign competitors are so keen for their custom.

I would urge anyone interested to learning more about international agriculture to consider attending the 16th Congress which will meet in Ireland in 2007.

Biographical Notes

Matthew Naylor farms 150 hectares in South Lincolnshire. He produces potatoes, flowering bulbs, vining peas and sugar beet, and has a subsidiary enterprise producing specialist cut flowers for UK supermarkets and a potato packing facility which handles imported potatoes for the food service sector. He is a former NFU Young Farmer of the Year and a past winner in the Grower of the Year Award and attended the Worshipful Company of Farmers 54th Course in Advanced Business Management at Imperial College, Wye. He is the Vice-Chairman of a Leader+ EU funding programme, a director of Fens Tourism and an East Midlands Rural Business Champion. He is a current Nuffield Scholar with the subject "Understanding the British Brand".

ABSTRACTS

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4259 BENNETT, R.; UPELAAR, J. **Updated estimates of the costs associated with thirty four endemic livestock diseases in Great Britain: a note.** *Journal of Agricultural Economics* (2005) **56** (1) 135-144 Uckfield, UK; Agricultural Economics Society [En, 7 ref.] Department of Agricultural and Food Economics, The University of Reading, Reading, Berkshire RG6 6AR, UK. Email: R.M.Bennett@rdg.ac.uk

This note outlines the further development of a system of models for the estimation of the costs of livestock diseases, first presented by Bennett (*Journal of Agricultural Economics* (2003) **54**, 55-71). The models have been developed to provide updated and improved estimates of the costs associated with 34 endemic diseases of livestock in Great Britain, using border prices and including assessments of the impact of diseases on human health and animal welfare. Results show that, of the diseases studied, mastitis has the highest costs for cattle diseases, enzootic abortion for sheep diseases, swine influenza for pig diseases and salmonellosis for poultry diseases.

4377 WORSFOLD, D. **Promoting excellence in food hygiene.** *Nutrition & Food Science* (2005) **35** (1) 6-14 Bradford, UK; Emerald Group Publishing Ltd [En, 17 ref.] Food Research and Consultancy Unit, University of Wales Institute, Cardiff, Wales, UK.

An article is presented outlining some of the benefits and limitations of the new Welsh Hygiene Award Scheme (WHAS). The benefits and limitations of the scheme are considered in relation to consumers and the industry. The WHAS appears to be popular with award winners, some of the local authorities and most of the public who are aware of it. It is too early to determine whether the initiative has resulted in an overall improvement in the hygiene standards of businesses. Unfortunately, the initiative does not inform the public of actual standards in food premises. This lack of transparency mainly relates to a lack of information for businesses and the public, limited publicity for the scheme in the media and the evident need to educate the public. The article adds to the limited literature on the evaluation of similar initiatives. Given that the FSA is considering the option of launching a national food hygiene award scheme, there is a need to carefully evaluate this and other schemes before finalizing options.

4461 BHAVANI SHANKAR; NEELIAH, H. **Tropospheric ozone and winter wheat production in England and Wales: a note.** *Journal of Agricultural Economics* (2005) **56** (1) 145-151 Uckfield, UK; Agricultural Economics Society [En, 21 ref.] Department of Agricultural & Food Economics, University of Reading, Reading, Berkshire RG6 6AR, UK. Email: b.shankar@rdg.ac.uk

Tropospheric ozone is an air pollutant thought to reduce crop yields across Europe. Much experimental scientific work has been completed or is currently underway to quantify yield effects at ambient ozone levels. This research seeks to directly evaluate whether such effects are observed at the farm level. This is done by intersecting a farm level panel dataset (for the years 1993-98) for winter wheat farms (n=116) in England and Wales with information on ambient ozone, and estimating a production function with ozone as a fixed input. Panel data methods, generalized methods of moments (GMM) techniques and nested exogeneity tests are employed in the estimation. The results confirm a small, but nevertheless statistically significant negative effect of ambient ozone levels on wheat yields.

4620 UPTON, M.; OTTE, J. **The impact of trade agreements on livestock producers.** In *Responding to the livestock revolution: the role of globalisation and implications for poverty alleviation* [Edited by Owen, E.; Smith, T.; Steele, M. A.; Anderson, S.; Duncan, A. J.; Herrero, M. (etal)]. Nottingham, UK; Nottingham University Press (2004) 67-84 ISBN 1-904761-51-8 [En, 17 ref., BSAS Publication 33] Department of Agricultural and Food Economics, School of Agriculture, Policy and Development, The University of Reading, Barley Gate, PO Box 237, Reading RG6 6AR, UK.

In the context of the growth of imports of livestock products in the developing countries, this chapter examines the impact of (free) trade agreements on livestock producers in these countries. It is indicated that, theoretically, all countries are expected to benefit from free trade since it allows each to concentrate on those products for which it has the greatest comparative advantage. However, import tariffs, like those imposed by the EU, USA and Japan, together with other non-tariff barriers obstruct free trade and reduce global welfare, including that of potential developing country exporters. Furthermore, trade agreements between groups such as the EU create trade between members but reduce trade with third countries.

4636 RIDDELL, I. Single farm payment: impact on the UK beef industry. *Cattle Practice* (2005) **13** (1) 41-44 Frampton-on-Severn, UK; British Cattle Veterinary Association [En] SAC Perth, Cleave Gardens, Oakbank Road, Perth, PHI 1HF, UK. Email: Iain.Riddell@sac.co.uk

The beef cattle industry faces a period of uncertainty following the replacement of headage subsidies by the Single Farm Payment on 1st January 2005. Decisions taken by individual farmers to decrease or increase cattle numbers will have a major impact on UK beef production, ancillary industries and the veterinary profession. Scaling back numbers is likely to provide a short-term fix to farm businesses since the Single Farm Payment will gradually reduce and reducing numbers does not necessarily reduce fixed costs. Farmers looking to remain in beef production in the long term need to cut significant costs from their production systems. This is most easily achieved through increasing scale of operation, specialisation into the part of production that suits their resources best, and co-operation with others as demonstrated by members of Borders Quality Beef Co-operative. Successful farmers of the future will need to adopt a more market orientated, businesslike approach that involves more data collection and benchmarking of performance. They are also likely to make more use of consultancy services and the veterinary profession to ensure business profitability.

4768 TOKARICK, S. Who bears the cost of agricultural support in OECD countries? *World Economy* (2005) **28** (4) 573-593 Oxford, UK; Blackwell Publishing [En, 16 ref.] International Monetary Fund, Washington, DC 20431, USA.

This paper provides quantitative estimates of the impact of removing agricultural support in both OECD and developing countries in partial and general equilibrium frameworks. The results show that agricultural support in OECD countries is highly distortionary, and tariffs have a larger distortionary impact than subsidies. Removal of agricultural support would likely raise the international prices of food, resulting in an increase in the cost of food for many net-food importing countries, although the size of the increase is generally small. The results also show that most of the benefits from removing agricultural support accrue to the countries that liberalize.

4787 POPPE, K. J.; MEIJL, H. VAN Adjustment and differences in farm performance — a farm management perspective from the Netherlands. *Report - Agricultural Economics Research Institute* (LEI) (2004) No.2.04.09, 37 pp. Den Haag, Netherlands; Landbouw-Economisch Instituut (LEI) [En, 31 ref.] Agricultural Economics Research Institute (LEI), Burgemeester Patijnlaan 19, P.O. Box 29703, 2502 LS The Hague, Netherlands.

This paper reviews past research in the Netherlands on the topic of differences in farm performance, and considers the policy relevance of this material. Research has shown that the managerial capacities of farmers play a major role in differences in economic and environmental performance. Farmers differ in their objectives, competencies and local external situation and therefore their strategies. In recent years, strategic management has become more important and this can be supported with consultancy. Farmers also differ in their adoption and innovation behaviour. These micro-economic results, which correlate with large differences in income and high prices of fixed assets with a limited supply, can be explained as being consistent with economic theory on perfect markets. Although these findings suggest that some farm households have attractive strategies that can cope with policy adjustments, the research supports, but does not (yet) prove, the hypothesis that a severe adjustment of agricultural policy, e.g. towards a more market-oriented policy, induces more innovation, and that due to this innovation the effects of adjusting the agricultural policy are less severe than estimated ex ante with current dynamic policy models.

4867 HERMANN, O. [Must weeding of sugar beet always be so expensive?] Le desherbage de la betterave doit-il toujours être si coûteux? *Betteravier (Bruxelles)* (2005) 39 (413(Special issue)) 12-14 Brussels, Belgium; Confederation des Betteraviers Beiges [Fr]

On the basis of a review of weed control systems applied to sugar beet at 62 sites during 2004, a cost was calculated of approximately 200 Euro/ha. In 26 of the sites, the cost of weed control was greater than the average. Methods of reducing the costs of weed control are listed, including: a good knowledge of the flora; early intervention; exploitation of climatic conditions, pre-emergence treatment; choice adapted to the products and their costs; reduction of the use of graminicides; avoidance of the use of potatoes in the crop rotation; and use of appropriate spray equipment.

4900 UK, THE ECONOMIST **Stirrings in the corn fields.** *Economist (London)* (2005) 375 (8426) 75-77 London, UK; Economist Shop [En] 25 St James' Street, London SW1A 1HG, UK.

This paper reports that biofuels (biodiesel and ethanol) are no longer a mere "green" diversion from the real world and are in fact starting to change energy markets. It is pointed out that in the USA's maize states, locally-produced ethanol is close to being competitive even without subsidy; at today's prices, E85 ethanol is only 10 cents or so from being cheaper than standard gasoline even without subsidies. In Europe, biodiesel is 10-12 euro-cents a litre cheaper than plain diesel. Some figures on the biodiesel output of the USA, Europe and Brazil are presented.

4905 JAMES, A. **The state of veterinary epidemiology and economics.** In *Tenth symposium of the International Society for Veterinary Epidemiology and Economics (ISVEE), Vinal del Mar, Chile, November 2003*. [Edited by Urcelay V., S.; Pinto C, J.]. *Preventive Veterinary Medicine* (2005) **67** (2/3) 97-99 Amsterdam, Netherlands; Elsevier [En] Veterinary Epidemiology and Economics Research Unit, The University of Reading, School of Agriculture, Policy and Development Earley Gate, P.O. Box 237, Reading RG6 6AR, UK. Email: veera@reading.ac.uk

Recent developments in the fields of veterinary epidemiology and economics are critically reviewed and assessed. The impacts of recent technological developments in diagnosis, genetic characterisation, data processing and statistical analysis are evaluated. It is concluded that the acquisition and availability of data remains the principal constraint to the application of available techniques in veterinary epidemiology and economics, especially at population level. As more commercial producers use computerised management systems, the availability of data for analysis within herds is improving. However, consistency of recording and diagnosis remains problematic. Recent trends to the development of national livestock databases intended to provide reassurance to consumers of the safety and traceability of livestock products are potentially valuable sources of data that could lead to much more effective application of veterinary epidemiology and economics. These opportunities will be greatly enhanced if data from different sources, such as movement recording, official animal health programmes, quality assurance schemes, production recording and breed societies can be integrated. However, in order to realize such integrated databases, it will be necessary to provide absolute control of user access to guarantee data security and confidentiality. The potential applications of integrated livestock databases in analysis, modelling, decision-support, and providing management information for veterinary services and livestock producers are discussed.

4999 COLMAN, D.; SOLOMAN, A.; GILL, L. **Supply response of U.K. milk producers.** *Agricultural Economics* (2005) **32** (3) 239-251 Boston, USA; Blackwell Publishing [En, 24 ref.] School of Economic Studies, University of Manchester, Manchester M13 9PL, UK. Email: david.colman@man.ac.uk

Short-run own-price response elasticities are estimated from two samples of panel data for specialist dairy farms in the Northwest and Southwest of England. Although these farms are subject to milk marketing quotas, the free tradability of quotas enables them individually to adjust the output quite rapidly. Model specifications have been chosen to test the ability of panel data to directly reveal behavioural responses without the imposition of theoretical restrictions. Significantly, the two independent samples generate quite similar results,

especially in terms of supply response measures. Stable and promising estimates are obtained with simultaneous models giving higher elasticities than single equation models.

5455 BURRELL, A. EU enlargement to Turkey? The challenges ahead for agriculture and rural areas. *Eurochoices* (2005) 4 (1) 12-17 Uckfield, UK; Agricultural Economics Society and the European Association of Agricultural Economists [En, de, fr] Wageningen University, Hollandseweg 1, 6707 KN Wageningen, Netherlands. Email: Alison.Burrell@wur.nl

In December 2004 the European Council agreed that accession negotiations with Turkey could begin in October 2005. Although the Copenhagen political criteria have been decisive so far, the criteria relating to the functioning of markets and ability to implement EU legislation will weigh heavily in the negotiations. Despite recent policy reforms, Turkey's agriculture still enjoys levels of protection similar or higher than those of the EU, but its gross value added per worker is relatively very low. One third of Turkey's employment is in agriculture, where most farms are small. The animal health situation is far below the standard achieved in the EU. Food supply chains are fragmented and inefficient. To survive and compete within the single market of the EU, the agricultural and food sectors must undergo deep structural change, which will have far-reaching economic and social repercussions. Projections according to current policy trends show that Turkey could take over one-third of the total cohesion budget allocation. However, the scaling-down or delaying of budget transfers would be short-sighted. If the EU accepts Turkey as a member it would be in the interest of the EU as a whole that Turkey's economy - and especially its backward rural economy - should embark on a sustainable growth path as soon as possible.

5457 CHANTREUIL, F.; LEVERT, F.; ERJAVEC, E.; DONNELLAN, T.; HANRAHAN, K. CAP reform: prospects for crop markets in the enlarged EU. *Eurochoices* (2005) 4 (1) 26-31 Uckfield, UK; Agricultural Economics Society and the European Association of Agricultural Economists [En, de, fr] Unite d'Economie et Socio-logie Rurales, INRA-Rennes, Rennes, France. Email: Frede-ric.Chantreuil@rennes.inra.fr, Fabrice.Leveret@rennes.inra.fr, Emil.Erjavec@bfro.uni-lj.si,tdonnellan@rerc.teagasc.ie, khanrahan@rerc.teagasc.ie

Agricultural Policy Modelling in the EU has become more complicated due to the recent CAP reform and EU Enlargement. Under the AGMEMOD (Agricultural Member States Modelling) Partnership, teams of economists with specialist knowledge of agriculture in their own countries have come together to build the AGMEMOD model. The model can be used to analyse the impact of policy reform at a country level in EU member states and at an aggregate EU level. The model covers a wide variety of agricultural commodities, but this article focuses specifically on the impact of the policy reform on the cereals sector. Results are presented for the EU15 in aggregate, the New Member States (NMS), Bulgaria and Romania. The implication of EU Enlargement is also examined for the accession countries. For the EU15, results suggest that there would be a modest reduction in grain production and a slightly larger reduction in oilseeds production by 2010, as a response to the decoupling of cereal payments. Results for the NMS suggest that their accession will bring some modest growth in grains production by 2010. This result is not greatly different from that which might have been achieved had these countries remained outside the EU. The recent reforms limit the extent to which the CAP stimulates increased production in the NMS.

5678 CLARKE, J. Effective marketing for rural tourism. In *Rural tourism and sustainable business* [Edited by Hall, D.; Kirk-patrick, I.; Mitchell, M.]. Clevedon, UK; Channel View Publications (2005) 87-102 ISBN 1-84541-011-4 [En, 18 ref., Aspects of Tourism 26] The Business School, Oxford Brookes University, Headington Campus, Gipsy Lane, Oxford OX3 0BP, UK. Email: jrclarke@brookes.ac.uk

This chapter describes the context for rural tourism and its marketing, and examines the rural tourism product and demand with a marketing lens. By re-visiting the issues influencing marketing practices in rural tourism and through the presentation of a checklist for more effective marketing action, this chapter emphasizes the wider role of marketing for rural tourism and, in particular, the use of marketing at a strategic level.

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EDITORIAL

This issue contains papers covering a wide range of issues pertinent to farm management. Cain and Guy explore the cost of different welfare systems for breeding sows in the UK. Using expert opinion they devise a welfare score for different sow management systems and, by comparing this score against each system's production costs, show that indoor systems with the highest welfare scores also incur the highest production costs. This raises a key question, and one relevant for many animal production systems, are consumers prepared to pay higher prices for animal welfare benefits?

Tsourgianis and colleagues from Plymouth use factor and cluster analysis to identify the marketing strategies adopted by Greek sheep and goat farmers. They identify and match farm and farmer characteristics to three different marketing strategies: returns (profit) orientation, production orientation and cost focus. This methodology can be used to analyse the marketing strategies adopted by producers of other commodities and, as the study area in Greece resembles Cornwall in some important respects, there are also opportunities for comparative analysis to identify improved and innovative marketing strategies for farmers of both countries.

Paul Wilson and colleagues inform us that the "Farm Business Survey is the longest and most comprehensive continual series of information relating to the physical and financial performance of farm business in England and Wales". Their paper explores the origins, function and future of the Farm Business Survey and the Special Studies surveys, its sister publication reporting the financial performance of agricultural enterprises. The paper reviews how these data sets have been used to benefit the wider farming community. Defra's farm business benchmarking online tool, available at <http://www.farmbusinessbenchmark.defra.gov.uk/>, is another important step in delivering even more value from the Farm Business Survey.

James Jones's paper highlights important implications of key changes in the regulations for calculating agri-environment scheme payments in the Single Payment Scheme era. By drawing on three case-studies, he illustrates the wide variation in income forgone for farms enrolled into the same environmental prescriptions. He then examines the impact of the Single Payment Scheme on each farmer's income forgone. In future, environmental scheme payments will remain linked to profit forgone but the current incentive element will be withdrawn and replaced by an allowance for transaction costs. As farmers will retain the single farm payment whether they participate in an agri-environment scheme or not, its value must be excluded from income forgone. Will payments really be based on the negative profitability reported by many farm enterprises when subsidy payments are excluded from the value of total output? When payments are based on low or negative profitability plus some allowance for transaction costs, will they be sufficiently high to attract the required number of farmers into environmental schemes?

The paper from Sirieix and her colleagues outlines a methodology for examining consumers' ethical views: their methodology could be used to examine the ethical perspective of consumers faced with higher food costs derived from higher welfare standard production systems, thus addressing the potential problem identified by Cain and Guy. Labelling food products to be

both accurate and fair clearly raises difficult issues, as this paper demonstrates only too well. Interestingly, the views expressed by food purchasers differed from those expressed by employee of the company producing that food. One wonders if the employees changed their perspective when buying food that had not been produced by their employer.

The implications of the Mid Term Review reforms on animal caretakers is the subject of Seabrook's viewpoint article. Just how livestock farming systems will change following the Single Payment Scheme is difficult to predict, so Seabrook discusses several alternative scenarios.

The decoupling of the single farm payments from production will represent a crossroad for many farmers. However, Musgrave's account of the changes he has overseen on three farms on the Wiltshire downs shows that today's farm businesses are the combined result of many previous changes and adjustments; many farm businesses have re-structured and diversified away from the traditional-farming income streams, but perhaps few have been restructured and diversified as extensively as these.

Jeremy Franks
Editor

REFEREED PAPER

COUNTING THE COST OF IMPROVED WELFARE FOR BREEDING SOWS IN THE UK*Cain, P. J. and Guy, J. H.*

The last 20 years have seen significant changes in the way in which sows are housed in the UK with a switch towards outdoor and less intensive indoor systems. This has implications for both sow welfare and costs of production. This study used systems models to calculate the costs of weaner production under a variety of dry sow and farrowing housing systems, and assessed each system for sow welfare. The results show that the outdoor system has the highest welfare score and lowest production costs, whilst amongst the indoor systems, the systems offering the highest welfare also have higher production costs.

Keywords: pig production costs, weaners, sow welfare, housing systems, spreadsheet modelling.

Introduction

Previous research by this group (Bornett *et al.* 2003) examined the effects of increased animal welfare standards on the costs of growing and finishing pigs in the UK. This paper reports on a subsequent study which focussed on the breeding sow phase of the production cycle and analysed the costs of producing weaner pigs under systems with different levels of welfare for the sow. The study used a simple modelling technique to calculate the production costs under a range of housing systems and also allocated welfare scores to each system.

The last 20 years have seen significant changes in the way in which sows are housed in the UK. There has been an increase in the proportion of sows kept outdoors, and within the indoor systems, there has been a switch to less intensive group-based systems. Systems where sows and gilts are kept in stalls or tethers were prohibited in the UK from 1.01.1999, although European Union (EU) legislation permits the use of stalls until 1.01.2013 (EU 2001). Recent UK legislation in the form of the Welfare of Farm Animals (England) (Amendment) Regulations 2003 (Schedule 6, Part IV) specifies in some detail the housing and feeding systems under which sows and gilts can be kept. These regulations require the animals to be kept in groups, in pens of certain minimum dimensions, using a feeding system which ensures individuals can obtain sufficient food, and require also the provision of a sufficient quantity of bulky or high fibre material. Whilst such regulations are designed to improve animal welfare there are likely to be effects on the costs of pig production.

This paper firstly describes the housing and feeding systems used for both pregnant (“dry”) and farrowing sows in the UK and ascribes a welfare ranking to each of the systems. The modelling methodology and data used are then briefly explained and finally the results of the models, in terms of costs of weaner production under the different systems, are discussed.

Sow Housing Systems in the UK

Indoor housing systems can be characterised by building construction, pen configuration, floor design and the feeding system used. The results of a 2002 survey of sow accommodation in the UK (Gloag, 2002) are shown in Table 1. For dry sows, outdoor systems accounted for about 25 % of sows and the two main indoor systems used were deep-bedded straw yards and kennels. The principal feeding systems adopted in the straw yards were dump (feed scattered into the yard from an overhead hopper) or electronic sow feeders (ESF). For kennel-housed sows the two main feedings systems were individual dry feeders or piped liquid feed.

Table 1 Survey of pregnant and farrowing sow housing systems in the UK (Gloag, 2002)

Housing system	Floor type	Feeding method	% sows in each system
Pregnant sow			
Outdoors	Cereal stubble	On ground	25.6
Straw yard + dump feeders	Deep straw	Dump	7.2
Straw yard + ESF	Deep straw	ESF	18.4
Kennel + Individual feeders	Minimum straw	Individual feeders	23.6
Kennel + wet feeding	Minimum straw	Wet feeder	3.3
Stall	Part-slatted	Hand fed	0.5
Farrowing sow			
Outdoor	Cereal stubble	Nuts/Cobs on ground	28
Farrowing Crate	Solid	Hand fed	17
Farrowing Crate	Part slatted	Hand fed	46
Farrowing Crate	Fully slatted	Wet fed	3.5
Farrowing Crate	Fully slatted	Hand fed	n/a
Swing sided Crate	Fully slatted	Hand fed	n/a
Swing sided Crate	Fully slatted	Wet fed	n/a
Traditional Pen	Minimum straw	Hand fed	3

The small proportion of UK sows housed in confined systems (still permitted on very small units) contrasts strongly with the situation in some other European countries. Table 2, derived from data collected for the European Union's Scientific Veterinary Committee (EU 1997), shows the high proportions of dry sows kept in confined systems in the Netherlands, Denmark, France and Italy. In order to examine the relative costs of all the systems, this study included the stall-based system which was widely adopted during the 1960's because of ease of management, control of sow aggression and feed rationing, as well as economic advantages.

Against this background, six different dry sow systems were selected for this study as specified in Table 3.

Table 2 Popularity of different types of confinement housing for pregnant and farrowing sows in Europe (EU 1997)

Housing system	UK (%)	Netherlands (%)	Denmark (%)	France (%)	Italy (%)
Pregnant sow					
Sows Confined	15	30	34	22	5
Crates	20	60	54	41	63.5
Group Housing	69	10	12	37	31.5
Farrowing sow					
Sows Confined	9	40	40	33	1
Crates	86	60	60	58	99
Sows loose with pigs	10	1	1	9	-

In the case of the farrowing sow, there are two predominant systems – the outdoor ark and the indoor farrowing crate used with a variety of floor types. Table 1 shows that, in the 2002 survey, 28 % of sows farrowed outdoors, and about 67 % indoors in conventional crates. Very few sows farrowed either in crates which were capable of being opened ("swing-sided") or in any form of traditional, unconfined pen. In contrast to the dry sow systems, systems for the farrowing sow are more similar across European countries as Table 2 shows.

Table 3 Sow housing systems chosen for production cost modeling

Housing system	Code	Building	Floor	Feeding system
Pregnant sow				
Outdoor	Outd	Shelter hut	Minimum straw	Hand fed
Sow Yard	Dump	Large yard	Deep straw	floor dump
Sow Yard	ESF	Large yard	Deep straw	ESF
Kennel	Ken D	Small yard	Deep straw	Individual feeder
Kennel	Ken W	Small yard	Deep straw	Wet
Stall	Stall	Cubicle	Part-slatted	Individual feeder
Farrowing sow				
Outdoor	Outd	Hut	Minimum straw	Hand fed
Farrowing pen	Pen	Non-insulated	Minimum straw	Hand fed
Swing-sided crate	Swing W	Insulated	Fully-slatted	Wet fed
Swing-sided crate	Swing D	Insulated	Fully-slatted	Hand fed
Farrowing crate	Crate N	Insulated	Solid	Hand fed
Farrowing crate	Crate P	Insulated	Part-slatted	Hand fed
Farrowing crate	Crate SW	Insulated	Fully-slatted	Wet fed
Farrowing crate	Crate SD	Insulated	Fully-slatted	Hand fed

The various permutations of crate type, floor construction and feeding system which are available to producers resulted in the specification of eight farrowing sow systems represented in this study as shown in Table 3.

Animal welfare in sow housing systems

It can be difficult to gauge the level of welfare of animals in any production system, however there are many studies on the welfare of sows which have used both biological measurements and behavioural observation in order to try to do so. Marchant and Broom (1994) compared stall-housed dry sows and those kept in loose housed systems. In physical terms they found that the stall-housed sows had reduced bone strength and muscle conformation, leading to difficulties for these animals when standing up or lying down and increased risk of slipping. In other behavioural studies it has been reported that the stall-housed sows are less responsive to stimuli – e.g. water being poured on their backs. Broom (1986) had also argued earlier that stall-housed sows were relatively unresponsive to events around them, found their living conditions difficult to cope with and suffered reduced welfare as a consequence. A higher incidence of abnormal oral behaviours and the development of stereotypies are the most publicised observations of confinement systems for pregnant sows, and whilst their biological significance may be still poorly understood, stereotypies are generally accepted to indicate reduced welfare (Edwards 1992). In the case of the farrowing sow, the predominant housing system is the farrowing crate which offers a number of advantages over loose housed systems. These include reduced piglet mortality, easier management at farrowing and better disease control (EU1997). There are however concerns about the welfare of the sow in such systems as they impose severe restrictions on the movement of the sow and reduce the possibilities for natural nest building behaviour. However, alternative systems which permit more freedom for the sow but protect the piglet still require further development to harmonise with large scale commercial production (Edwards and Fraser 1997). There is also evidence that the level of animal welfare in a particular system is strongly influenced by the quality of management and stockmanship (Edwards 1992) although this could not be taken into account in this study.

The sow housing systems included in this study were scored and then ranked according to the expected level of welfare afforded the sows (but not the piglets) in each system. The scoring was agreed by a group of experienced animal scientists and based on evidence available from the published literature relating to each of six attributes of the systems. These attributes were: freedom of movement; equity of feed distribution; feed satiation (gut fill); average space allowance; bullying avoidance; and availability of a substrate. Within each dry sow or farrowing sow system, each attribute was scored out of a possible maximum of 10 points. The relative importance of each characteristic in contributing to overall welfare was then weighted as a fraction of one. The scores and weights are shown in Tables 4a and 4b. Within the whole array of possible permutations of dry sow / farrowing sow systems (6 x 8 or 48 combinations in all), 15 combinations were chosen on the basis of those most commonly found in practice in the UK. For example, the most popular

farrowing system, the part-slatted farrowing crate, was included in combination with all the dry sow systems excluding the outdoor system. Similarly, the most popular dry sow system, kennels with individual dry-fed feeders, was represented in combination with all the dry-fed farrowing options. The animal welfare score for each system combination of the dry sow and farrowing sow phases was re-calculated by weighting each separate phase score according to the proportion of time spent by the sow in that phase – 0.85

Table 4a Welfare scores for the attributes of the six dry sow systems – out of 10 points.

Attribute	Dry sow systems						Weighting
	Stalls	Ken W	Ken D	ESF	Dump	Outd.	
Freedom of movement	1	6	5	6	7	9	0.3
Equity of feed	10	5	10	9	4	6	0.2
Satiation	1	8	6	6	6	7	0.1
Space allowance	1	5	5	6	6	9	0.15
Bullying avoidance	6	5	5	6	6	8	0.1
Substrate	1	6	6	7	7	8	0.15
Weighted score	3.3	5.75	6.25	6.75	6.05	7.95	

Table 4b Welfare scores for the attributes of the eight farrowing sow systems out of 10 points.

Attribute	Farrowing system								Weighting
	Crate SD	Crate SW	Crate P	Crate N	Swing D	Swing W	Pen	Outd.	
Freedom of movement	1	1	1	1	4	4	6	9	0.3
Equity of feed	10	10	10	10	10	10	10	10	0.2
Satiation	6	7	6	6	6	7	8	9	0.1
Space allowance	2	2	2	2	6	6	8	9	0.15
Bullying avoidance	10	10	10	10	10	10	10	10	0.1
Substrate	1	1	2	3	1	1	7	8	0.15
Weighted score	4.35	4.45	4.5	4.65	5.85	5.95	7.85	9.15	

in the dry sow accommodation and 0.15 in the farrowing accommodation – and summing the two. Each of the 15 system combinations therefore received a unique score as shown in Table 5, and from that each was ranked in order between 1 and 15. There appear to be few studies which have attempted to score complete breeding sow systems on the basis of animal welfare, although Bracke et al (2002) did rank pregnant sow systems. In that study the tether system was ranked 1 (low) and an outdoor, semi-natural system, received the highest ranking of 15.

Table 5 Selected sow housing combinations and their animal welfare scores [#] and ranks (in parenthesis)

	Farrowing system	Outd	Pen	Swing W	Swing D	Crate N	Crate P	Crate SW	Crate SD
Pregnant system									
Outd		8.13 (15)							
ESF						6.44 (13)	6.41 (12)		
Ken D			6.49 (14)		6.19 (11)	6.01 (10)	5.99 (9)		5.97 (8)
Dump							5.82 (7)		5.80 (6)
Ken W				5.78 (5)			5.56 (4)	5.55 (3)	
Stall							3.48 (2)		3.46 (1)

[#] Welfare score weighted for average occupancy of either pregnant (0.85) or farrowing (0.15) housing system

Models and data used to estimate costs

Production costs were estimated for a unit size of 300 breeding sows, which was, at the time, similar to the UK national average for an indoor breeding sow unit of 330 sows (MLC 2002). Assuming a farrowing rate of 2.2 litters per sow per year, an average weaning age at that time of 25 days and allowing time to wash farrowing crates between batches, this requires 60 farrowing, 250 dry sow places and a service area. Models were constructed in spreadsheet format using a common structure of six worksheets with the first five linked to the final sheet where the total costs of production per sow and per weaned piglet were estimated for that particular dry/farrowing sow housing combination. The structure was as follows:

- Sheet 1. Model pig unit specification (number of sow places, standard sow performance specification).
- Sheet 2. Buildings related data (costs and resource use for each sow housing system).
- Sheet 3. Standard unit costs (costs per unit of resource e.g. labour, power, feed).
- Sheet 4. Pregnant sow system physical performance (data specific for each sow housing system).
- Sheet 5. Farrowing sow system physical performance (data specific for each sow housing system).
- Sheet 6. Total production cost (calculated per sow and per weaner for each combination).

There are a number of parameters which define performance of both the pregnant sow and farrowing sow phases, which effectively determine the ultimate physical productivity of the whole unit when expressed as weaners produced per sow per year. For the purposes of setting up the model, each parameter was defined as either 'basic', that is a biological value depending on animal performance, or 'derived', simply a mathematically-linked consequence of the basic parameters (see Table 6). For example, in the farrowing sow phase, piglets born alive and pre-weaning mortality are both basic parameters taken in the case of the model pig unit from national statistics for typical UK sow herds (MLC 2002), whilst piglets weaned per litter is a mathematical derivation of these data. Some sow performance parameters (e.g. pre-weaning mortality) are influenced by, and therefore will vary across, housing system, although there are limited experimental data from controlled experiments using the range of housing systems compared in this study. A review of published trial results was undertaken to collate sow performance data for different housing systems. An example of data collated for the farrowing phase is given in Table 7, for the farrowing crate system, using data from 9 publications, describing 14 data sets. The basic average performance parameters calculated for each specific system were expressed as an index against the standards of the model pig unit. For example, where a specific system had a performance level estimated to be 5 % lower than the model pig unit, this system had an index of 0.95 for that parameter in Sheets 4 or 5. This allowed a combined index of performance to be calculated for a specific pregnant/farrowing sow housing combination which was then used in estimating costs.

Table 6 Sow performance parameters used for model pig unit.

Category	Basic data	Derived data
Pregnant sow	Farrowing % (i.e. % successful services)	
	Sow mortality rate	
	Sow replacement rate	
	Non-productive days per service	
Farrowing sow	Weaning age (days)	Number of litters/sow/year
	Number of pigs born/litter	Number of pigs weaned/litter
	Number of pigs born alive/litter	Number of pigs weaned/sow/year
	Pre-weaning mortality (%)	

The main cost-related data used in the models were the costs of building construction, the level of resource use (labour, power etc.) in operating the various types of buildings and the unit costs of the resources. Building construction and estimated annual repair costs were derived from quotations obtained from a number of UK commercial pig building companies, according to the specification of the model pig unit of 300 sows and an average construction cost was then calculated. This was used to estimate depreciation costs based on the expected lifespan of the various building types as shown in

Table 7. Reproductive performance of sows in farrowing crates.

Reference No.	17	28	28	31	35	35	35	36	22	17	17	40	41	44	Average
Litters per sow per year	2.2										2.2				2.20
Pigs born per litter				11.5	11.5	11.3	11.7					12.2			11.64
Pigs born alive	11.0	10.6	10.8	10.7	11.0	10.7	11.0	11.3			11.0	11.5	10.3	11.6	10.96
Pigs reared per litter	9.6			9.4	9.8	9.7	10	9.6					9.7	10.1	9.74
Pre weaning mortality %	12.5	11.4	14.4	12.1	12.1	10.3	10.2	15.7		11.7	13.2		5.8	12.9	11.86
Pigs per sow per year	21.5														21.5
Averagen weaning age (days)									25.6						25.6

References: 17, EU (1997): 22, Sheppard (1998): 28, Rantzer and Svendsen (2001): 31, Silver (1989): 35, Pedersen *et al.* (1998):36, Weber (2000): 40, Arey and Sancha (1996): 41, Dewhirst (1992): 44, Wechsler *et al.* (1997).

Table 8. Resource inputs included the amount of labour, bedding and machinery (for general sow husbandry, slurry and solid manure disposal) required in each of the different systems and were derived from a number of sources and are shown in Table 9. Standard unit costs were collated for feedstuffs, labour, machinery and power (see Table 10). The spreadsheet models were used to calculate the total and average costs of production under the 15 different pregnant/farrowing sow housing combinations.

Table 8 Construction costs, building lifetimes and repair costs of different sow housing systems.

Basic system	Code	Capital building cost (£/sow place)	Cost per sow in herd (£)	Expected building lifetime (years)	Expected repairs (% of capital cost)
Pregnant sow					
Outdoor	Outd	54.70	46.31	15	0.6
Sow Yard	Dump	455.00	385.19	30	0.3
Sow Yard	ESF	510.00	431.75	30	0.3
Kennel	Ken D	662.00	560.43	20	0.3
Kennel	Ken W	530.50	449.11	20	0.3
Stall	Stall	520.50	440.64	30	0.45
Farrowing sow					
Outdoor	Outd	361.14	70.92	15	0.6
Farrowing pen	Pen	1700	333.87	30	0.3
Swing-sided crate	Swing W	1950	382.96	20	0.45
Swing-sided crate	Swing D	2417	474.68	20	0.45
Farrowing crate	Crate N	1667	327.38	20	0.45
Farrowing crate	Crate P	2244	440.70	20	0.45
Farrowing crate	Crate SW	1933	379.62	20	0.45
Farrowing crate	Crate SD	2117	415.76	20	0.45

Table 9 Resource use for the different sow housing systems (values are per sow place per annum).

System	Labour (hours)	Straw (tonnes)	Slurry output (m ³)	Cost of slurry disposal (£)	Solid manure output (tonnes)	Cost of solid manure disposal (£)	Total cost of waste disposal (£)	Muck/slurry machinery hours	Standard tractor use (hours)	Total machinery (hours)
Pregnant sow										
Outd	10.2	0.56	0.00	0.00	0.00	0	0.00	0.00	2.10	2.10
Dump	13.8	0.56	0.00	0.00	2.22	5.3	5.34	0.36	0.70	1.06
ESF	13.8	0.56	0.00	0.00	2.22	5.3	5.34	0.36	0.70	1.06
Ken D	12	0.28	0.00	0.00	1.94	4.6	4.66	0.31	0.70	1.01
Ken W	12	0.28	0.00	0.00	1.94	4.6	4.66	0.31	0.70	1.01
Stall	10.2	0	1.66	2.86	0	0	2.86	0.19	0.70	0.89
Farrowing sow										
Outd	6.8	0.75	0.000	0.00	0	0	0.00	0.00	1.40	1.40
Pen	9.2	0.28	0.000	0.00	1.01	2.42	2.42	0.16	0.60	0.76
Swing W	7.2	0	0.741	1.28	0	0	1.28	0.09	0.60	0.69
Swing D	8	0	0.741	1.28	0	0	1.28	0.09	0.60	0.69
Crate N	9.2	0	0.741	1.28	0	0	1.28	0.09	0.60	0.69
Crate P	8	0	0.741	1.28	0	0	1.28	0.09	0.60	0.69
Crate SW	7.2	0	0.741	1.28	0	0	1.28	0.09	0.60	0.69
Crate SD	8	0	0.741	1.28	0	0	1.28	0.09	0.60	0.69

Table 10 Standard input costs.

Resource	Description	Unit	Cost/unit
			p
Feed ^a	Pregnant sow nuts/cobs (outdoor)	p/kg	10.33
	Lactating sow nuts/cobs (outdoor)		11.95
	Pregnant sow compound		10.13
	Lactating sow compound		11.75
	Pregnant sow wet-feed ration		8.10
	Lactating sow wet-feed ration		9.40
	Pregnant sow home-milled ration		8.81
	Lactating sow home-milled ration		10.22
			£
Veterinary input & medicine	Pregnant sow – indoor housed	Per sow per annum	5.93
	Farrowing sow – indoor housed		25.05
	Pregnant sow – outdoor housed		5.93
	Farrowing sow – outdoor housed		17.06
Machinery ^b	Tractor hour	Per hour	15
	Slurry disposal	Per m ³	1.72
	Solid manure disposal	Per tonne	2.4
Bedding	Straw	Per tonne	30
Labour ^c	Stockperson of average skill	Per hour	7.52
Power and water	Average cost	Per sow/annum	17.00
Artificial Insemination ^a		Per service	3.63
Land rent	Suitable for outdoor pig keeping	Hectare	160

^a Average price obtained from commercial UK suppliers in July 2003.

^b Nix (2003).

^c Agricultural Wages Board UK (AWB, 2004).

Results

Although the models calculated production costs on both per sow and per weaner bases only the latter are reported here since they combine the effects of both unit costs and physical performance for each system. Table 11 shows the production cost per weaner under each of the 15 system combinations and the welfare score ascribed to the system. Costs ranged from £22.39 per weaner for

the outdoor system up to £27.45 for the kennel/traditional farrowing pen combination. The variation in costs across different systems is best illustrated by comparing across a single dry sow system in combination with a number of farrowing systems, or down a single farrowing system used in combination with a range of dry sow systems. Comparing across the most popular dry sow system – the dry-fed kennel (Ken D) - shows that in the farrowing phase, conventional crate systems produce similar costs to the new swing-sided crates, which were both still cheaper to operate than the traditional farrowing pen. In the case of dry sow systems, taking the most popular farrowing system – the partially slatted conventional crate (Crate P) – shows that the lowest cost was in combination with the stall accommodation and wet (W) feed systems were generally cheaper to operate than the dry feed counterparts. In the large group systems dump feeding methods proved to be lower cost than the electronic sow feeders (ESF).

Table 11 Total production costs per weaner (£ GB) and animal welfare rank (in parenthesis) of different sow housing combinations.

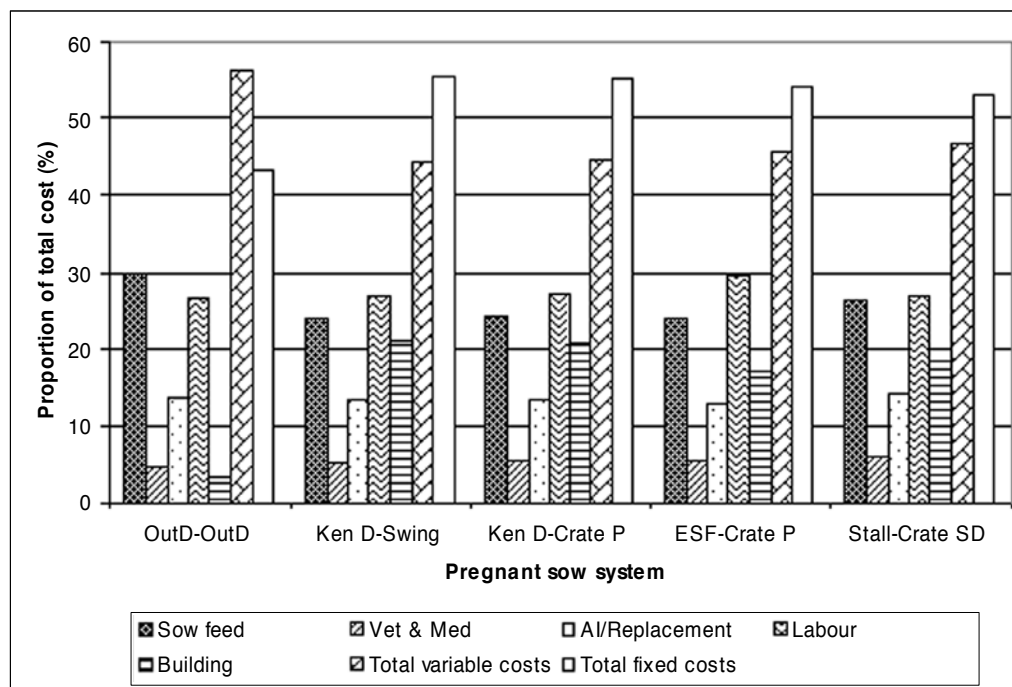
	Farrowing Outd system	Pen	Swing W	Swing D	Crate N	Crate P	Crate SW	Crate SD
Pregnant system								
Outd	22.39							
	(15)							
ESF					25.92 (13)	26.17 (12)		
Ken D		27.45		26.28	25.83	26.08		25.93
		(14)		(11)	(10)	(9)		(8)
Dump						25.44 (7)		25.29 (6)
Ken W			23.65 (5)			24.65 (4)	23.63 (3)	
Stall						23.34 (2)		23.19 (1)

Within all the indoor systems, the lowest cost was achieved by the sow stall/farrowing crate system which was calculated at £23.19, some £4.26 per weaner or 15 % lower than the highest cost system. These are clearly significant differences in production costs for an industry where profit margins have been narrow. On the typical breeding unit modelled in this study, producing about 6,500 weaners per year, this represents a cost difference of almost £28,000 per year. However, the sow kennel/crate combination based on liquid feed (Ken W/Crate SW) showed a weaner cost of £23.63 which was

only some 44p / weaner (about £3,000 per year) or about 2 % more expensive than the stall system.

The system combinations differ in the relative importance of the various cost components. Figure 1 shows the breakdown of costs, in percentage terms, for the five most popular systems, into five cost components and also into total fixed and total variable costs. This shows that fixed costs predominate in the indoor systems (around 55 % of total costs), and variable costs constitute the highest proportion on the outdoor unit. Within fixed costs, buildings obviously form a very low proportion in the outdoor system, at about 4 %, but make up around 20 % of costs in the indoor units. As might be expected, the stall system had low building costs but not as low as the system with sows in large straw yards with electronic feeders. In the case of labour costs, these were a higher proportion in the electronic sow fed system and similar, at about 26 %, across all others. Within the variable cost group, feed formed a higher proportion (30 %) of costs outdoors than in the indoor systems.

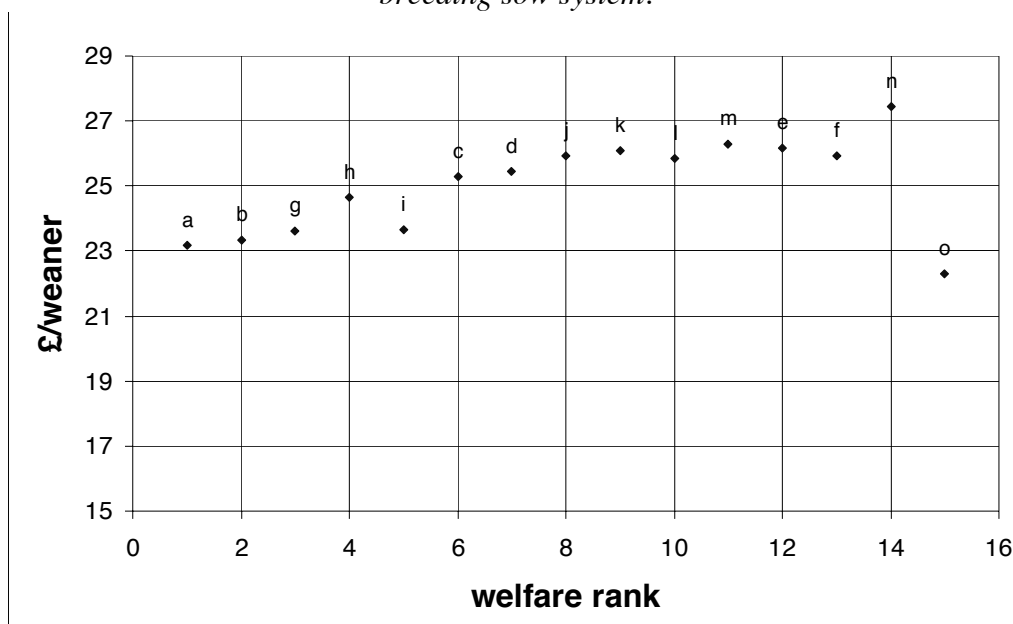
Figure 1 Components of production costs for selected sow housing combinations.



The results also provide some insights into the relative cost of running breeding sow systems which differ in their welfare attributes. Figure 2 is a plot of production costs against welfare rankings for the 15 systems. It is clear that the outdoor systems offer high welfare at the lowest production costs – point “o” in Figure 2. Within the indoor systems there appears to be some positive correlation between welfare improvement and production cost but this is not consistent across the range of systems. Because of the time spent by the sow in each phase of the production cycle, the characteristics of the dry sow

accommodation have a major impact on the overall welfare score and ranking of any combination. The stall-based systems (“a” and “b” in Figure 2) have the lowest welfare scores but also the lowest production costs of the indoor systems. One of the large group dry sow systems, that with dump feeding, has an average rating for welfare and is also average in terms of production costs (points “c” and “d” in Figure 2), whereas the other large yard dry sow system, with ESF, is only slightly more expensive but ranks considerably higher on welfare grounds (“e” and “f” in Figure 2). However, housing systems with liquid feed facilities offer only low-level welfare, with ranks between 3 and 5, but do have lower production costs. To achieve the highest levels of welfare indoors does appear to increase production costs cost progressively. In this group of systems, with ranks between 8 and 12 using kennels for the dry sow, the conventional crates are the least cost option for the farrowing sows (points “j”, “k” and “l”), with swing sided crates slightly more costly and traditional farrowing pens the most expensive option (points “m” and “n” respectively).

Figure 2 Weaner production costs and associated welfare ranks for each breeding sow system.



Key:

a	Stall/Crate SD	b	Stall/Crate P	c	Dump/Crate SD
d	Dump/Crate P	e	ESF/Crate P	f	ESF/Crate N
g	Ken W/Crate SW	h	Ken W/Crate P	i	Ken W/Swing W
j	Ken D/Crate SD	k	Ken D/Crate P	l	Ken D/Crate N
m	Ken D/Swing D	n	Ken D/Pen	o	Outd/Outd

Conclusions

The general conclusion of this study is that pig production costs tend to be higher in systems which are judged to provide better conditions for the sow's welfare. Part of the higher cost of constructing and managing these higher welfare systems may be off-set by better animal performance although, in the

case of loose farrowing systems the converse may be true due to higher piglet mortality. The differences in average production costs between housing systems may be small but 2004 survey data for breeding and finishing herds (MLC 2005) suggest an average gross margin per pig sold of £23.70 and average fixed costs of £23.64, clearly leaving a negligible net margin.

Compliance with legislation enacted to improve animal welfare does impose a cost on the producer. In this respect, the ban on stalls and tethers in the UK had a significant impact on production costs here. There is an argument which can be made for a price premium for meat produced from higher welfare systems, purely on the basis of costs of production, but this ignores all the issues about whether consumers are prepared to pay such a premium.

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Biographical notes

Philip Cain is Senior Lecturer in Farm Business Management at the University of Newcastle. He is the Farms Director with responsibility for the University's two farms and pig research unit. Philip read Agriculture at Newcastle, completed a PhD there and then spent 12 years managing farms in the Midlands before returning to Newcastle. His research interests focus on analysing the effects on farm profitability of changes in agricultural technologies and policies.

Jonathan Guy studied BSc. Agriculture and then completed a PhD in pig production at the University of Newcastle upon Tyne. After a brief period teaching at an agricultural college in Yorkshire, he returned to Newcastle to take up a Research Associate position modelling the effect of housing systems on the cost of finishing pig production. Now a Lecturer in Pig and Poultry Science, Dr Guy's research interests cover aspects of health, welfare and production of both pigs and poultry. Current specific projects include nutrition of broiler chickens and laying hens, development of alternative control strategies for Red Mite in laying hens and environmental enrichment.

REFEREED PAPER

PROFILES OF SHEEP AND GOAT FARMERS' MARKETING STRATEGY IN THE REGION OF EAST MACEDONIA AND THRACE IN GREECE

L. Tsourgiannis, J. Eddison, M. F. Warren and A. Errington

This study aims to profile the marketing strategies that the sheep and goat farmers follow in the Region of East Macedonia and Thrace (EMTh) in Greece based upon their distribution channel selection, farm and personal characteristics. Data were collected through personal interviews with 343 sheep and goat Greek farmers in the Region of East Macedonia-Thrace. Three marketing strategies were identified: (i) cost focus, (ii) production orientation and (iii) return focus strategy. The main difference between strategies was that the return focused farmers were mainly medium scale livestock producers whereas cost focused farmers were large scale livestock farmers. The production-orientated farmers had better financial performance than the other two groups resulting from a focus on improvement of their productivity.

Key words: Livestock marketing, marketing strategies, livestock marketing channels, strategic typology, sheep farmers.

Introduction

Marketing channel decisions are very important in the farming sector because it consists of a large number of small agricultural holdings, most of the agricultural products are “undifferentiated” and the farming enterprises are isolated from the final consumer (Ritson 1997). The distribution channel is one of the tools that an organization typically employs in order to achieve its marketing objectives within the framework of its marketing strategy (Fifield 1992; Kotler 1994). The farming sector, however, is characterised by a lower emphasis on the marketing function than most other industries. Most farmers’ marketing orientations, according to Allen (1997) simply relate to the process of selling their products. This is partly because the majority of the farmers have only minimal control over the movement of their output through the marketing system, and minimal opportunity for adding value (Haines 1999).

In the business literature, there are many studies which develop the business typologies and taxonomies. Miles and Snow (1978) categorised organisations into three basic types according to the way they behave strategically: (i) defender, (ii) prospector and (iii) analyser, with the aim of assessing the dominant culture of the organisation. Porter (1980) identified three internally consistent generic strategies for creating a defensible position in the long-run for competitors in an industry. The three generic strategies that a firm may adopt are: (a) overall cost leadership, (b) differentiation and (c) focus. Following on from this, four broad strategies based on the above generic strategies were suggested by Fearn and Bates (2000): (i) cost leadership strategy, (ii) differentiation strategy, (iii) diversification strategy and (iv) specialization strategy. Kohls and Uhl (1990) argued that in the food industry most firms mainly adopt the following two strategies: product differentiation and market segmentation.

It can be difficult to use the typologies of business strategies described

above to describe adequately the way agricultural businesses behave, due to the nature of farm firms (especially their small scale and dependence on family labour and management) and the environment in which they operate. Generally, little is known about the decision making process of farmers regarding marketing strategy selection and particularly about the factors and the farmers' characteristics that influence them to choose a particular strategic alternative. Some studies have sought to cluster farmers according to their strategic behaviour. Mitchell (1976) examined the extent to which farmers were influenced in their livestock marketing decisions by publicly available information on prices and supplies. He identified product-orientated, selling-orientated and market-orientated livestock producers. McLeay *et al.* (1996) identified five strategic groups of crop farmers in New Zealand, while Ohlmer, *et al.* (1998) clustered Swedish farmers in relation to their decision making.

Other studies have attempted to identify the factors that influence farmers to adopt a particular marketing strategy. For example, distribution risk is one factor that influences marketing decision making in the agribusiness sector. Risks that agricultural producers face are linked with decisions about the prices, quantity, quality, and the timing of delivery (Royer, 1995). Transaction cost was identified as another factor, which has significant impact on marketing decision-making (Hobbs, 1996). Age, education and farm profit are also, according to Hobbs (1997) some of the factors that affect farmers use of live auction markets: the type of cattle, quick payment and the price received were the most important reasons for selling cattle live-weight.

However, there is limited objective evidence relating to the strategic management process of farmers, and particularly about the factors that influence their choice of a specific marketing strategy. Hence this study, which attempts to identify marketing strategies through analysis of the factors that affect farmers' marketing attitudes, using data relating to sheep and goat farmers in the Region of East Macedonia and Thrace (EMTh) in Greece. The aim is to profile each of the identified marketing strategic groups in the sheep and goat livestock sector, regarding the characteristics of the farms and the farmers themselves as well as the preferred livestock distribution channels. It also aims to explore the association between the factors that influence the farmers of each strategic group to choose a particular distribution pattern and their selection of a particular marketing strategy (derived by multivariate analysis).

Methodology

Sampling method

The Region of EMTh in Greece was chosen as a study area because it has many similarities with the county of Cornwall in U.K., where a parallel marketing survey (into livestock sheep farmers) was being conducted. Both regions have been designated as Objective One Regions by the E.U., are located close to the researchers' principal place of study, and are quite isolated compared to the rest of their countries: East Macedonia and Thrace is situated in the North East edge of Greece, and Cornwall in the South West corner of

United Kingdom. They each have populations of about half million people and their agricultures are dominated by ruminant livestock production.

A sample frame including information about 6,826 farmers that operate in the Region of EMTh was obtained from the Local Authorities in the Region of EMTh. A random selection of sheep and goat farmers was selected for the sample, to allow the authors to generalize their findings beyond the sample of farms covered by the survey. A stratified random sample was employed, with each district (Prefecture) being represented in the same proportion as in the main population. This ensured a more efficient estimation of some population characteristics that might exist in each Prefecture (e.g. large and small farmers) than would be available by simply randomly sampling from the population at large). To check that the selected sample was reasonably representative, its characteristics were compared with those of the total population following the methodology advocated by Errington (1984).

The sample consisted of 343 sheep and goat farmers, comprising 5% of the total population of sheep and goat farmers registered in local authorities' lists of 6,826 people according to the data compiled by Xanthi Prefectural Authority (2001), Rhodopi Prefectural Authority (2001), Evros Prefectural Authority (2001), Kavala Prefectural Authority (2001) and Drama Prefectural Authority (2001). Furthermore, the sheep and goat population of the sample, which is 31,295 and 27,257 animals respectively, account for 5.5% and 5.6% of the total sheep and goat population of the Region of EMTh that is, according to N.S.S.G (1999), 580,451 and 491,372 animals. The average size of the sheep and goat farms that consists of the sample of this study is 91 and 79 head, respectively. Furthermore, the average size of the sheep and goat enterprises of the Region of EMTh is, according to N.S.S.G (1999), 90 and 79 head, respectively. This gives some confidence that the sample that was used for this research is representative of the total population of the Region of EMTh.

Survey methodology

Field interviews were used for data collection, a method considered more appropriate where the research subject is relatively unfamiliar to the respondent, covers sensitive topics, or where respondents have poor literacy, face language difficulties and are quite old or very young (Errington 1984; Oppenheim 2000). In this study, where most sheep and goat farmers in the Region of East Macedonia in Greece had poor literacy and were not familiar with this kind of research, field interviews provided the interviewer with the opportunity to explain the utility of the project and its aims and objectives. The length of the questionnaire, the size of the sample and the dispersion of the farms were some additional factors considered in adopting the interview method.

The survey was pre-tested on six sheep and goat farmers in the Prefecture of Xanthi. As a result, minor alterations were made to the questionnaire prior to the pilot survey. In Autumn 2001, a pilot survey consisting of field interviews was conducted with 30 farmers, 6 in each Prefecture. Farmers were selected using random numbers. The purpose of the pilot survey was to test

and validate the questionnaire design and to estimate the response rate of the main survey. The response rate to the pilot survey was 93%, and it was not felt that any further changes were required for the main survey. Thus the main survey comprised 343 farmers, began in March and was completed in April 2002. There was a productive response rate of 92%: 314 farmers answered the questionnaires; whilst 17 farmers had sold their flock; 4 farmers had died; 1 farmer had moved to another part of the country; 2 farmers refused to answer; and 5 farmers were not found.

Questionnaire design

The questionnaire was designed taking into consideration the marketing and strategic variables identified in the literature relating to business and agricultural marketing, farm management, agricultural economics, and strategic management. As a starting point, attention was given to existing conceptual frameworks such as Porter's (1980) generic strategies, Miles and Snow's (1978) strategic typologies, Mitchell's (1976) and Davies' (2001) livestock, as well as McLeay's *et al.* (1996) arable typologies. Taxonomic classifications of strategy including strategic group studies were also reviewed. This was followed by informal interviews with farmers, business consultants specialized in the agricultural sector, managers of firms processing and trading agricultural products, and agricultural economics academics, in order to gain a detailed knowledge of the industry prior to selecting the appropriate variables. Finally, a ten-page questionnaire was designed to identify the marketing strategies and marketing channels used by farmers, the factors that influence them to choose a particular distribution pattern, as well as the characteristics of their farms and the farmers themselves. The questionnaire regarding livestock marketing was designed in six parts in order to meet the research objectives:

Part 1 – Choice criteria for selecting marketing channels in the meat sector: this consisted of 5 questions related to marketing channel used, choice criteria, agricultural cooperative membership and sales price regarding meat and livestock marketing. This section would be used to determine the marketing channel used.

Part 2 – Management activities and attitudes: this consisted of 25 attitudinal statements recorded on a 5 point Likert scale relating to marketing and business orientations. These questions covered areas such as non-controllable factors, marketing activities, consumer/buyer orientation, production planning and budgetary control.

Part 3 – Marketing or added value questions relating to differentiation.

Part 4 – General farm characteristics: this consisted of 11 questions related to characteristics such as farm size, flock/herd size, volume of produce and farm area. This section was of particular relevance with regard to profiling the derived typologies after multivariate statistical analysis.

Part 5 – General farmer's characteristics: this consisted of 10 questions related to characteristics such as farm and non-farm previous working experience, income, debt level, age and education.

Statistical Methodology

Multivariate analysis techniques were used to reveal the key information contained in the responses, and these analyses were applied in three stages. First, principal component analysis (PCA) was used to identify the variables that accounted for the maximum amount of variance within the data in terms of the smallest number of uncorrelated variables (components). In this study, PCA reduced the 25 key attitude variables (listed in Appendix I) which relate to various aspects of marketing strategic activity, to a smaller set of 11 strategic dimensions (V3, V4, V5, V6, V7, V10, V11, V12, V13, V24 and V25).¹ Second, factor analysis was conducted on these 11 variables in order to reduce them to a smaller number of underlying factors (or dimensions).² Factor analysis enables scores to be calculated for each underlying factor, and these are substituted for the original variables. These factor scores were then subjected to cluster analysis to group farm businesses with similar patterns of scores into similar clusters based on their strategic behaviour.^{3,4} Quadratic discriminant analysis was performed to assess how accurately the identified key strategic dimensions that were derived from the factor analysis could predict and discriminate strategic group membership.

Statistical tests based on the outcomes of the multivariate statistical techniques presented above (factor, cluster and discriminant analysis) are used to test five hypotheses:

H1: Sheep and goat farmers in Greece (Region of EMTh) can be classified into strategic groups regarding their livestock marketing activities and business orientations;

H2: Farmers that follow different marketing strategies are influenced in their distribution channel selection by different factors;

H3: The factors that influence Greek sheep and goat farmers to the selection of a particular livestock marketing channel are associated with the selection of a specific livestock marketing business strategy;

H4: The identified livestock marketing business strategies are related with the

1. The anti-image correlation matrix was used as well as Bartlett's test of sphericity and measure of sampling adequacy (MSA) to check the appropriateness of the data for subsequent factor analysis. The variables that had a high proportion of large absolute values of anti-image correlations as well as MSA less than 0.5 were removed before analysis.

2. An orthogonal rotation (varimax method) was conducted and the standard criteria of eigenvalue = 1, scree test and percentage of variance were used in order to determine the factors in the first rotation (Hair *et al.* 1998) different trial rotations followed where factor interpretability was compared.

3. In this study, both hierarchical and non-hierarchical methods were used according to the recommendations of Hair *et al.* (1998) and Punj and Stewart (1983) in order to develop a typology of the marketing strategies that sheep and goat farmers follow in the Region of EMTh in Greece.

4. A non-parametric Kruskal–Wallis one way ANOVA was conducted to validate the cluster solutions by examining if variables not used in cluster analysis differ significantly among the identified clusters.

selection of particular livestock marketing channels; and

H5: The farm and farmer's characteristics are associated with the selection of a particular livestock marketing strategy.

Results

Description of the identified marketing strategies

Principal components and factor analyses (through a varimax rotation) were conducted, and the latent root criterion (eigenvalue =1), the scree plot test and the percentage of variance were used to determine the number of factors. All three criteria suggested that there were three factors in the first rotation.⁵

Table 1 Results of Principal Components Analysis of Strategy Variables.

Components (or variables)	Eigenvalues	% of Variance	Cumulative Variance %	Variables
1	3.335	30.318	30.318	V3
2	2.531	23.007	53.325	V10
3	1.397	12.700	66.025	V11
4	0.8229	7.537	73.561	V4
5	0.775	7.046	80.607	V7
6	0.624	5.676	86.284	V24
7	0.498	4.532	90.815	V12
8	0.362	3.290	94.106	V25
9	0.265	2.412	96.518	V5
10	0.218	1.980	98.499	V6
11	0.165	1.501	100.00	V13

Factor analysis identified three factors which explained the 66% of the total variance (Table 1). The factor loading scores of the eleven variables onto the three factors are presented in Table 2. The cut-off point used to interpret the factor loading scores was 0.59, much higher than the 0.35 required according to Hair *et al.* (1998) for samples of at least 250 observations in order to achieve 0.05 significance level and 80% level of power.

In the next stage, cluster analysis was used to develop a typology of the marketing strategies that sheep and goat farmers adopt in the Region of EMTh in Greece (Harrigan 1985; Helsen and Green 1991; Hair *et al.* 1998; Siardos 1999). Cluster analysis differs from factor analysis in that the former groups objects (in this case farms or farmers), whereas the latter is concerned with grouping variables. Factor scores are standardised (mean = 0, standard deviation =1). Therefore, any cases with factor scores greater than ± 3.0 are removed as outliers. Consequently, cluster analysis was conducted on only 289 observations, as 25 cases were removed because their factor scores exceeded ± 3.0 .

5. Several different trial rotations were conducted to compare factor interpretability as suggested by Tabachnick and Fidell (1989), Child (1990), Malhotra (1996), and Hair *et al.* (1998).

Table 2. Key Strategic Dimension Derived from Principal Component Analysis.

KEY STRATEGIC DIMENSIONS		Factor Loading
Profit Orientation		
V4	Maximizing profit is my most important farming goal.	0.861
V6	When I have finished my livestock I must sell immediately and can not afford to wait for prices to improve.	0.854
V7	I have no influence over the price I receive for my meat produce	0.829
V24	Policies of other countries have little influence on my farm profitability relative to meat sector.	-0.687
V25	Disease is the major cause of fluctuations on my farm returns.	0.593
Production Orientation		
V13	I always set aside a proportion of my production flock to experiment with livestock techniques relative to meat production I am not familiar.	0.848
V10	I breed animals which requires special knowledge, equipment or facilities that other farmers do not have.	0.836
V11	I maximize meat quality by using special techniques such e.g. artificial insemination.	0.660
V12	I adapt my enterprise mix to minimize risk.	0.617
Cost focus		
V5	Budgeting and planning to obtain the lowest possible farm costs is the most important management activity I undertake.	0.924
V3	I am aware of the exact costs and returns of the meat I produce.	0.913
Determinant of Correlation Matrix: 0.008149.		
KMO MSA = 0.73.		
Bartlett Test of Sphericity = 1483.86 <0.001.		

Hierarchical and non-hierarchical clustering methods were used, which identified three clusters of farms/farmers that were named according to the business strategy that the farmers in each group appeared to follow. These are: (a) the Cost Focus Strategy, (b) the Production Orientation Strategy and (c) the Return (Profit) Focus Strategy. In particular, the **cost focus strategy** was adopted by 47% of the sample. These farmers according to the results of cluster and factors analyses were highly aware of the exact cost of the livestock they produce, and were very interested in budgeting and planning their production in order to achieve the lowest possible farm cost. They were not so keen on profit maximization because these farmers were mostly concerned with reducing their farm cost and not with achieving high sale prices or dealing with financial aspects that would lead to additional profit. On the other hand, they were not interested in production orientation strategic issues, presumably because of the costs incurred by activities relative to increasing livestock quality, experimenting with new livestock production techniques and breeding animals that required special knowledge.

The **production orientation strategy** was preferred by 11% of the examined farmers. These farmers set aside a proportion of their flock in order to experiment with new livestock techniques, and they bred animals that required special knowledge and equipment. Moreover, they were to some extent concerned with the cost focus, as they invested a larger amount of money in production facilities, equipment or genetic material compared to other farmers, aiming in this way to increase their productivity and hence

reduce their average cost in the long-term. Besides, they intended to improve the quality of their meat production and thus to differentiate their farm in some way. On the other hand, they did not regard profit maximization as their primary farm goal, nor were they interested in external factors which might affect their farm profitability. It is likely that the intention of these farmers was to increase their returns in the long term through the increase of their productivity and the reputation that they produce high quality products.

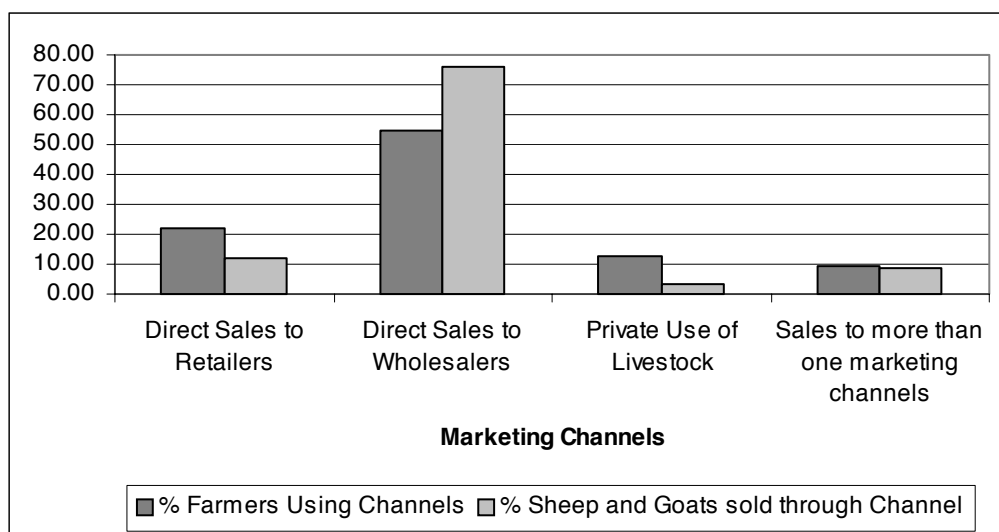
Finally, the **return (profit) focus strategy** was followed by 42% of the sample. These farmers were highly interested in maximizing their profits and tried to sell their livestock immediately because they could not wait for better prices as the quality of their livestock would have declined. They believed that they were not able to influence the configuration of the prices they would receive for their produce as they believed that these prices were mostly affected by other external factors such as the Common Agricultural Policy, WTO, a globalisation of the economy. Therefore, they considered that policies of other countries significantly affected their farm profitability. On the other hand, they lacked interest in improving the quality of their products, breeding livestock that require special knowledge, equipment and facilities that other farmers in their area did not have; nor were they concerned with budgeting and programming their facilities in order to reduce their farm cost. In short, their intention was to achieve short-term profits rather than programme their farm operation in order to increase their productivity and reduce their operational costs in the longer-term.

Therefore, the hypothesis *H1: Sheep and goat farmers in Greece (Region of EMTh) can be classified into strategic groups regarding their livestock marketing activities and business orientations* may be accepted.

Marketing Channel Selection and Livestock Marketing Strategies

The four main marketing outlets that the sheep and goat farmers utilize in

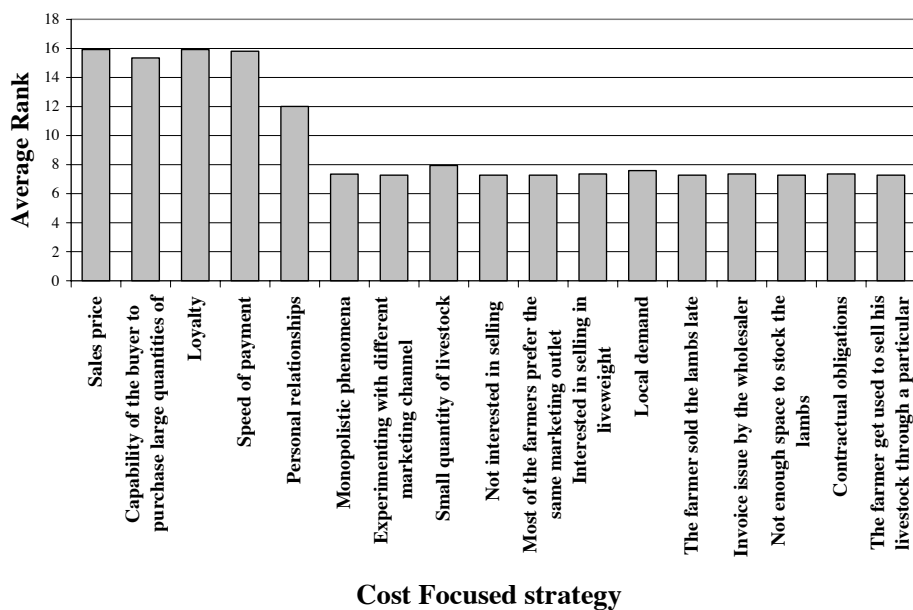
Figure 1 Categorization of sheep and goat marketing channels regarding livestock marketing.



the Region of EMTh in Greece, were identified from the survey, and are illustrated in Figure 1.

As the Friedman test indicates, the cost-focused, production-orientated and return-focused farmers were influenced by the same factors regarding their distribution channel selection, but the importance of each factor was different for each strategic group. The cost-focused farmers were influenced in their choice by in ranked order of importance, sale prices, loyalty of the buyer, speed of payment and capability of the buyer to purchase large quantities of livestock (Figure 2).

Figure 2. The factors that influence the cost focused sheep and goat farmers in EMTh in their marketing channel selection.



The farmers who followed the production-orientation were mainly affected in their marketing outlet choice by in a rank order of importance the capability of the buyer to purchase large quantities of livestock, loyalty of the buyer, speed of payment and sale prices.

Finally, the majority of the return-focus group were influenced in their choice by in a ranked order of importance the loyalty of the buyer, sale prices, speed of payment and capability of the buyer to purchase big quantities of livestock.

Thus, the hypothesis *H2: Farmers that follow different marketing strategies are influenced in their distribution channel selection by different factors* may be accepted.

The Kruskal–Wallis non parametric test identified factors that influence farmers to choose a particular marketing channel and which affected the marketing strategy selection of these farmers. Table 3 illustrates the influence of each factor to the selection of each marketing strategy.

Figure 3. The factors that influence the production orientated sheep and goat farmers in EMTh in their marketing channel selection

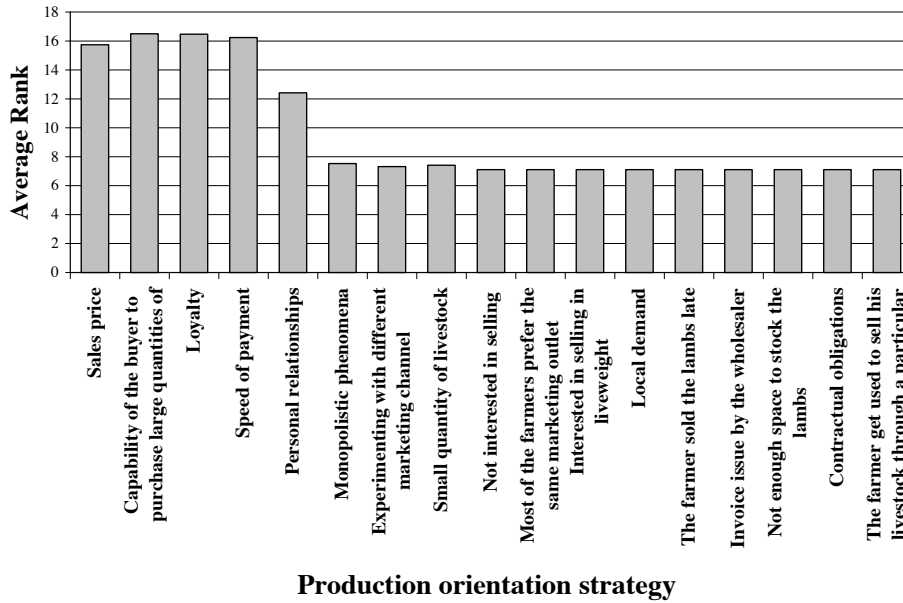


Figure 4. The factors that influence the return focused sheep and goat farmers in EMTh in their marketing channel selection

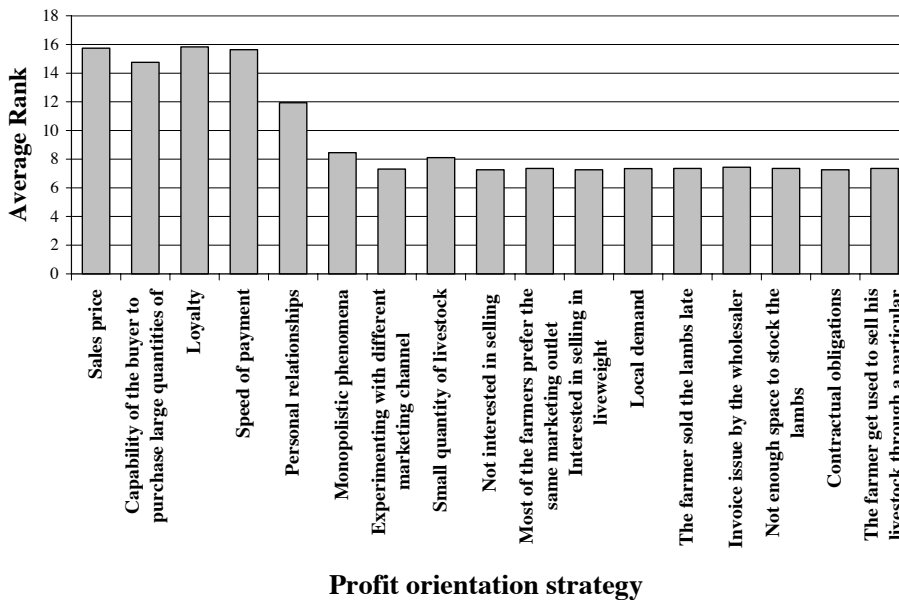


Table 3: The influence of each factor for the selection of a particular marketing strategy.

Factors	Marketing Strategies		
	Cost Focus Strategy	Production Orientation Strategy	Return Focus
Capability of the buyer to purchase large quantities of livestock	146.6 ^a	175.4 ^b	134.9 ^c
Loyalty	137.6 ^a	186.3 ^b	142.0 ^c
Speed of payment	140.8 ^a	184.1 ^b	139.0 ^a
Monopolistic phenomena	137.1 ^a	144.5 ^b	154.0 ^c

Within factors (rows), strategic groups (cells) with different superscripts differ significantly at $P < 0.05$.

Therefore, most of the sheep and goat farmers that were influenced by the capability of the buyer to purchase large quantities of livestock adopted the production-orientation strategy, as these farmers were interested in producing large numbers of lambs. Besides, the majority of the farmers that wanted to ensure they would be paid for the livestock they sold and receive their money quickly also followed the production-orientation strategy. On the other hand, the farmers that were operating in areas where monopolistic phenomena existed regarding the livestock marketing mainly adopted the return focus strategy. So, the hypothesis *H3: The factors that influence sheep and goat Greek farmers to the selection of a particular livestock marketing channel are associated with the selection of a specific livestock marketing business strategy* may be accepted.

The one sample chi-square test also identified a significant association ($P < 0.05$) between each strategic group and the selection of a particular livestock distribution pattern (Table 4). More particularly, the farmers of all the strategic groups preferred to market their livestock direct to wholesalers for the reasons presented above. Hence, the hypothesis *H4: The identified livestock marketing business strategies are related with the selection of particular livestock marketing channels* may be accepted.

Profiling each strategic group according to farm and farmers' characteristics.

A one-sample chi-square test was performed for each strategic group in order to develop the profile of the farmers who followed each marketing strategy regarding their farm characteristics and the characteristics of themselves.⁶ This study identified that most of the sheep and goat farmers who adopted the cost focus strategy had small farms in terms of cultivated land, big flocks and produced large volume of livestock. Generally, these farmers have similar profiles in terms of farm characteristics with the other two groups and all the sheep and goat farmers in EMTh. The difference exists only in terms of the volume of livestock production: most of the cost-focused farmers were large scale livestock producers, while the majority of the production-orientated farmers were medium scale producers. The cost-focused farmers owned most of the land they cultivated, preferred to rent less than 30% of their farm land from other farmers, while many of them let a small part of the land they

6. Statistics details of these characteristics are available from the authors.

Table 4. The livestock marketing channel utilization by each strategic group.

Marketing Channel Selection	Marketing Channel Selection	% of farmers	Standardized residuals
Cost Focus Strategy $\chi^2=114.630$, $df=3$, $P<0.001$	Direct Sales to Retailers	20.7%	-0.99 ^c
	Direct Sales to Wholesalers	63.7%	8.99 ^a
	Private Use of Livestock	5.2%	-4.60 ^a
	Sales to more than one marketing channel	10.4%	-3.40 ^a
Production Orientation Strategy $\chi^2=30.152$ $df=3$, $P<0.001$	Direct Sales to Retailers	24.2%	-0.09 ^c
	Direct Sales to Wholesalers	63.6%	4.44 ^a
	Private Use of Livestock	0.0%	-2.87 ^a
	Sales to more than one marketing channel	12.1%	-1.48 ^c
Return Focus Strategy $\chi^2=63.893$, $df=3$, $P<0.001$	Direct Sales to Retailers	24.8%	-0.05 ^c
	Direct Sales to Wholesalers	54.5%	6.50 ^a
	Private Use of Livestock	13.2%	-2.59 ^a
	Sales to more than one marketing channel	7.4%	-3.86 ^a

^a $P<0.05$ (strong association) , ^b $P<0.1$ and >0.05 (medium association), ^c $P<0.1$ (weak association).

owned to other farmers, presumably to obtain an additional income. Besides, these farmers preferred to allocate the largest part of the land they cultivated to their sheep and goat enterprise, probably in order to reduce feeding cost. Furthermore, the cost-focused farmers were neither involved in farm related activities away from their farm, such as meetings in agricultural organizations, nor with off-farm activities. They did not have any previous non-farm experience but they had long experience in livestock farming and in decision making relative to livestock sector. Moreover, most of these farmers had low levels of debt and derived the largest part of their farm income from their sheep and goat enterprise. They achieved average livestock prices compared to other farmers in their area and had low financial performance. The vast majority of them had low levels of education and did not hold any responsible position in an agricultural cooperative, nor in a non-farm business they might own. Therefore, the cost-focused farmers have similar profiles in terms of their personal characteristics to the other two groups and all the farmers in EMTh.

This study also identified that the production-orientated farmers had small farms, big flocks, owned most of their cultivated land and rent less than 30% of the land they cultivate from other landowners. Moreover, the majority of these farmers were not involved with off-farm activities. They did not have any previous non-farm experience, but they were well experienced in livestock farming and in decision making relative to the livestock sector. Most of the production-orientated farmers had low levels of debt. Their sheep and goat enterprise consisted of the main source of their farm income, while their financial performance and the livestock prices they achieved in the market

were about average compared to those of other sheep farmers who existed in their area. In addition, most of them had attended primary school and were not members of an agricultural cooperative. Therefore, the production-orientated farmers have similar profiles with the other two strategic groups and all the farmers in EMTh regarding their farm characteristics and the characteristics of themselves. On the other hand, they only differed in terms of financial performance. The majority of them had average financial performance in comparison with the other sheep and goat farmers operated in their area contrary to the other two groups and the whole sample of sheep and goat farmers operating in EMTh, whose financial performance was below average compared to other sheep and goat farmers operated in their area.

Finally, the sheep and goat farmers who preferred the return focus strategy had small farms, big flocks and medium volume of livestock production, as their main interest was not the increase of production efficiency but the profit maximization (short term profit in most cases). For the same reason most of them produced less than 10 tonnes sheep and goat milk annually. They owned the largest part of their farm land while they rented less than 30% of the land they cultivated from other farmers. On the other hand, many of these farmers preferred to let a small part of the land they owned to other farmers, presumably in order to obtain an additional income. They also allocated more than 60% of the land they cultivated to their sheep and goat enterprise. Besides, this study indicated that the sheep and goat farmers who adopted the return-focus strategy, were neither involved in farm-related activities away from their farm nor with off-farm activities. They did not have any previous non-farm working experience but they were well experienced in livestock farming and in decision making relative to livestock sector. Many of the return-focused farmers had low levels of debt, derived the largest part of their farm income from their sheep and goat enterprise and, even though they were profit seekers, they had low financial performance compared to the other farmers in their area because they mostly operated opportunistically: they were neither interested in improving the production efficiency of their farm nor in reducing their farm cost. The livestock prices that these farmers achieved were about average. This survey also identified that most of the examined farmers had attended the primary school. The vast majority of them did not hold any responsible position in an agricultural cooperative nor in a non-farm business they might own. Hence, the return-focus farmers have similar profiles regarding their farm's and farmers' characteristics with the cost-focused and production-orientated farmers as well as with all the sheep and goat farmers in EMTh.

Therefore, the hypothesis *H5: The farm and farmer's characteristics are associated with the selection of a particular livestock marketing strategy by the sheep and goat farmers in Greece* may be accepted.

Conclusions

As far as the sheep and goat farmers in Greece (Region of EMTh) are concerned, this study indicated that there was a significant association between the adoption of a particular marketing strategy, the factors that influence them to select a livestock-marketing channel as well as their personal characteristics

and the characteristics of their farms.

This study indicates that even though all the three identified strategic groups have similar profiles regarding farm and farmer characteristics, the production-orientated farmers have better financial performance than the other two groups. This may therefore suggest that, in order to increase their farm profitability and the sustainability of their livestock enterprise within an intensively competitive environment, the sheep and goat farmers in the Region of EMTh should focus on a production-orientation strategy. This would imply breeding animals that are characterised by high productivity (wean many lambs or weanlings and produce large quantities of milk) as well as modernise their farm (building and equipment) in order to increase their efficiency. The use of special production techniques such as artificial insemination can also work towards this aim. If they have the resources, they should further consider seeking economies of scale by expanding flock size, and increasing cultivated area in order to reduce feeding costs per head. A further opportunity for increasing profits is to add value to their products by processing a part of their produce by themselves and selling either directly to consumers through their own butcher shops or through local retailers. On the other hand, this is likely to increase enterprise risk, which they could reduce by marketing a part of their livestock production direct to wholesalers.

Moreover, they should focus on developing production and marketing synergies between livestock and milk produce. The fact that most of the sheep and goat farmers in EMTh were not members of agricultural co-operatives and did not hold any responsible position in any agricultural organisation implies the ineffectiveness of the Greek cooperative system regarding the livestock sector. There is a role for the Greek State in taking appropriate actions in order to make the cooperative system more effective and competitive and able to help the livestock farmers regarding the production and marketing of their products. Furthermore, the development of alternative sources of farm income, such as agro-tourism activities, may also increase the financial efficiency of the farm and may create additional marketing outlets for their lamb production. Finally, the parallel involvement of the farmers or their wives with off-farm activities will provide an additional source of family income thereby creating a minimum level of financial stability within the family, leading to an improvement of their quality of life.

A general limitation on all of the above is the low educational level of most of the sheep and goat farmers in this area, combined with a lack of involvement in off-farm activities. This is likely to inhibit their willingness, confidence and ability to take up new opportunities requiring different processes to those of traditional agriculture. Therefore the Greek State should focus on the improvement of the educational and professional training of the farmers with particular emphasis in animal production, management and marketing issues in order to ensure that the sheep and goat sector in the Region of EMTh in Greece has a chance of a better future.

It is not easy to find direct parallels with the British livestock marketing system due to very different structural characteristics (see for instance, Mitchell 1976, Murray et al. 1996, Hobbs 1997, Murray et al. 1998, Davies 2001 and Tsourgiannis et al. 2004a). Despite this, a parallel study suggests

quite similar livestock marketing strategies, as well as the marketing attitudes, between the sheep farmers in the Region of EMTh as they have been presented in this study and in the County of Cornwall. The factors that mainly influence the sheep farmers in both areas to select a particular marketing channel are basically the same, as are the farm and farmer characteristics that are significantly associated with the adoption of each marketing strategy (Davies 2001, Tsourgiannis et al. 2004a and Tsourgiannis et al. 2004b). The main difference is that the sheep farmers in Cornwall marketed only their livestock production, in contrary to Greek sheep and goat farmers who marketed both livestock and milk produce.

Generally, many of the suggestions of this study could be used for the improvement of the sheep sector in U.K. and other European areas which have been designated by the E.U. as Objective One Regions (poor regions), although similar research should be conducted for each specific case. Hence, in order the sheep sector in those areas to have a better future, the livestock farmers should aim to increase the efficiency of their farm by breeding animals characterised by high productivity and modernising their farms. Moreover, they should focus on adding value to their production and developing a farm market. Besides, the establishment of agri-tourism activities will generate additional sources of farm income and develop new livestock marketing outlets (e.g. restaurants, pubs, retail shops). Also, the involvement of farmers or other members of their family to off-farm occupations will add an extra source of income and improve the quality of their lives.

The suggestions of this study are in accordance with the new Regulation proposed by the Commission of the European Communities (Commission of European Communities 2005) regarding the Rural Development Policy for the period 2007 – 2013. The rural stakeholders (local and regional authorities, farming organisations etc.) of the Region of EMTh (and other European Regions after conducting similar studies) based on the findings of this study may participate actively to the development of the National Strategy Plans about Rural Development through the bottom-up approach that the proposed regulation adopted. Consequently this study may contribute to the achievement of the objectives of the rural policy of the E.U. which are the improvement of the competitiveness, sustainability and cohesion of the rural regions.

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Appendix I: Table A1(a) Variables used on the statistical analysis.

Factors affecting the livestock marketing strategy of sheep and goat farmers in Greece (Region of EMTh).	Farmer Characteristics.	Farmer's Characteristics.	Factors that influence choice a of marketing channel
<i>Farm Economics (5 point Likert Scale: 1 strongly disagree – 5 strongly agree</i>	V26. "Size of the land the farmer farmed in the year 2001"	V34. "The farmer is involved in farm related activities away from his farm e.g. Meeting in the Local Agricultural Cooperative, at market, other (YES/NO)"	V50. "Sale price
V1. "I plan my production decisions by continually monitoring market prices"	V27. "Size of the land that was allocated by the farmers to his sheep and goat enterprise in 2001"	V35. The farmer is working and earning income at another job away from his farm e.g. for other farmers, in a business, other (YES/NO)"	V51. "Capability of the buyer to purchase large quantities of livestock"
V2 "I have the lowest possible input costs"	V28. "Size of the total flock (sheep and goat excluded young animals) in 2001"	V36. "Number of years that the farmer has been involved in livestock farming (since the age of 16)"	V52. "Loyalty"
V3 "I am aware of the exact costs and returns for the meat I produce"	V29. "Volume of slaughtered sheep and goat (all ages) in 2001"	V37. "Number of years that the farmer has been in charge of making decisions on a livestock farm"	V53. "Speed of payment"
V4. "Maximizing profit is my most important farming goal"	V30. "Volume of milk production in 2001"	V38. "Hold of position (by the farmer) of more responsibility than normal voting member within an agricultural cooperative (YES/NO)"	V54. "Personal relationships"
V5. "Budgeting and planning to obtain the lowest possible farm costs is the most important management activity."	V7. "I have no influence over the price I receive for my meat produce"	V39. "Hold of position (by the farmer) of more responsibility than normal voting member within a farming organisation (YES/NO)"	V55. "Monopolistic phenomena"
V6. "When I have finished my livestock I must sell immediately and cannot afford to wait for prices to improve."	<i>Production Management (5 point Likert Scale: 1 strongly disagree – 5 strongly agree).</i>	V40. "Hold of position (by the farmer) of more responsibility than normal voting member within a non farm business that the farmer own (YES/NO)"	V56. "Experimenting with different marketing channels"
V7. "I have no influence over the price I receive for my meat produce"	V8. "I continually update the production techniques I use to produce my meat"		V57. "Small quantity of lambs"
V8. "I focus on meat production"	V9. "I focus on meat production"		V58. "The farmer is not interested in selling his livestock"
V9. "I focus on meat production"	V10. "I breed animals which require special knowledge and equipment or facilities that other farmers do not have"		
V10. "I breed animals which require special knowledge and equipment or facilities that other farmers do not have"	V11. "I maximize meat quality by using special techniques e.g. artificial insemination"		
V11. "I maximize meat quality by using special techniques e.g. artificial insemination"	V12. "I adapt my enterprise mix to minimize risk"		
V12. "I adapt my enterprise mix to minimize risk"	V13. "I always set a side a proportion of my flock to experiment with livestock techniques relative to meat		

Table A1(b) Variables used on the statistical analysis.

Factors affecting the livestock marketing strategy of sheep and goat farmers in Greece (Region of EMTh).	Farm Characteristics.	Farmer's Characteristics.	Factors that influence choice a of marketing channel
V15. "Intensive production methods are important to my farm business operation" <u>Marketing awareness (5 point Likert Scale: 1 strongly disagree – 5 strongly agree).</u>	V31 "Area of farm that the farmer owned in 2001"	V41. "Hold of position (by the farmer) of more responsibility than normal voting member by directing or managing a non farm business that the farmer does not own (YES/NO)"	V59. "Most farmers prefer the same marketing outlet"
V16. "I have detailed knowledge of the distribution channels my meat pass through after it leaves the farm"	V32. "Area of farm that the farmer rent or leased from other farmers in 2001"	V42. "Farmer's previous non farm working experience (YES/NO)"	V60. "The farmer is interested in selling in live weight"
V17. "I produce specialty, niche products e.g. organic"	V33. "Area of farm that the farmer rent or leased to other farmers in 2001"	V43. "What is the farmer's debt service (interest and principal payments) as a proportion of his farm income for the financial year of 2001"	V61. "Local demand"
V18. "I deal with a minimum number of marketing outlets so that I can maintain a good relationship with these channel members e.g. dairy firms"	V34. "Area of farm that the farmer rent or leased to other farmers in 2001"	V44. "What percentage of the farmer's farm income was derived from his sheep/goat enterprise"	V62. "The farmer sold the lambs late"
V19. "I own or manage facilities that are normally owned by middlemen further down the meat distribution chain e.g. farm shop, meat processing plant"	V35. "Area of farm that the farmer rent or leased to other farmers in 2001"	V45. "Farmer's financial performance compared to other livestock farmers (below average, average, above average)"	V63. "Wholesalers issue invoices which means that the farmer will get the VAT back"
V20. "I continually seek out new market outlets to sell new local milk processing plant"	V36. "Area of farm that the farmer rent or leased to other farmers in 2001"	V46. "Farmer's age"	V64. "There is not enough space to stock the lambs"
V21. "I plan my production to coincide with seasonal fluctuations"	V37. "Area of farm that the farmer rent or leased to other farmers in 2001"	V47. "Farmer's level of education"	V65. "The farmer get used to sell his livestock through a particular marketing channel"
<u>Farmers' psychological factors (5 point Likert Scale: 1 strongly disagree – 5 strongly agree).</u>	V38. "Area of farm that the farmer rent or leased to other farmers in 2001"	V48. "Member of Agricultural Cooperative (YES/NO)"	V66. "Contractual obligations"
V22. "Sheep/Goat Producers in my area are my main competitors"	V39. "Area of farm that the farmer rent or leased to other farmers in 2001"	V49. "Farmer's livestock prices compared to the prices of the other sheep/goat producers (below average, average, above average)"	
V23. "Keeping the knowledge I have from other farmers is essential to my farm profitability"	V40. "Area of farm that the farmer rent or leased to other farmers in 2001"		
<u>External environmental issues (5 point Likert Scale: 1 strongly disagree – 5 strongly agree).</u>			
V24. "Policies of other countries have little influence on my farm profitability relative to meat sector"			
V25. "Disease is the major cause of fluctuations on my farm returns"			

Appendix II – Validation.

The three identified strategic groups were validated using Kruskal–Wallis non-parametric one way ANOVA as this test is more robust in cases of ordinal data (Kinnear and Gray 2000). Eight strategic variables were selected for this validation process that had not been included in the factor analysis, that were significantly related, and referred to the five subject areas of the questionnaire. The eight variables that were examined to ascertain: (a) the importance of monitoring market prices (V1), (b) input cost (V2), (c) updating production techniques (V8), (d) animal welfare (V14), (e) intensive production methods (V15), (f) detailed knowledge of the distribution channels (v16), (g) seasonal fluctuations (v21) and (h) considering the other farmers as main competitors (v22).

Inter-cluster differences were observed in all the eight variables. All the strategic variables appeared to be important for all the strategic groups, but with the highest average ranks being for the production orientation strategy in every case. This means that production orientation farmers were more concerned with marketing aspects such as seasonal fluctuations and distribution channels as well as in farm economics (monitoring market prices, input cost) and production management (updating production techniques, animal welfare, intensive production methods) than the other two groups. They also believed, in a greater degree than the other two groups, that the other farmers in their area were their main competitors. On the other hand, all the variables except the animal welfare were more important for the cost focused farmers compared to those followed the return focus strategy.

An evaluation of the three identified key strategic dimensions was performed in order to assess how accurately could they predict and discriminate strategic group membership. Discriminant analysis was employed for this purpose. Prior to discriminant analysis the normality of the key strategic dimensions was checked. Outliers were removed and discriminant analysis was conducted on the remaining 177 cases. (Tabachnick and Fidell 1989). The Box's M test statistic (Box M= 295.292, approx F= 22.920, df =3191.7, $P<0.001$) indicated that the variance – covariance matrices were violated. Thus, the Bartlett Box F statistic was conducted additionally to assess the homogeneity of variance for each dependent variable (Siardos 2000). The Bartlett Box for “profit orientation” was 6.632 ($P=0.036$), for production orientation was 41.805 ($P<0.001$) and for “cost focus” was 0.033 ($P=0.219$). In inference, the Bartlett Box F statistic for each strategic dimension indicated that the equality of variance was violated and quadratic discriminant analysis was conducted in order to determine whether the identified variables could predict cluster membership in both cases. The predictive accuracy of the discriminant model was evaluated using the cross validation technique. The analysis indicated that 97.2% of the examined farmers were classified correctly. More specifically, the proportion of the farmers that were classified correctly in the cost focus strategic group was 98%, while 100% of the farmers that appeared to follow the production orientation strategy were correctly classified. On the other hand, 95.5% of the farmers that adopted the return focus strategy were correctly classified.

REFEREED PAPER

COST EFFICIENCY IMPROVEMENT IN MILK PRODUCTION, ENGLAND AND WALES 1997-2003.

David Colman and Yaqin Zhuang

Two virtually identical surveys of the economics of milk production in England and Wales were undertaken in 1996/7 and 2002/3. The samples were drawn from the populations of dairy herds of the time and provide an unusual opportunity to compare the change in cost efficiency of the England and Wales dairy herd over the six-year interval between surveys. Three different forms of measurement are presented. One is based on a simple weighted summation of the costs of production of each sample farm. A second is based on comparing estimated cost functions, of identical specification, for the two samples, and the third on a production function estimation. The three procedures generate similar results, namely that cost efficiency improved by between six and nine percent over the six-year interval.

Key words: economics of milk, production costs, efficiency, Cobb-Douglas production function.

Introduction.

The UK Department for Food, Environment and Rural Resources in conjunction with the Welsh Assembly Agriculture Department has continued the practice of MAFF in commissioning Special Studies on agricultural enterprises in England and Wales. The most recent such studies on the dairy enterprise were conducted in 1996/7 (Farrar and Franks 1998) and 2002/3 (Colman, Farrar and Zhuang 2004). In the first of these a sample of 377 specialist dairy holdings was studied and in the second 369. The samples were randomly drawn from the population of holdings identified in the June Agricultural censuses of 1994 and 2001. Thus the appropriate population weight for each sample holding can be measured, and estimates of population level performance measures can be calculated and compared for each of the two study years. Results of this analysis of changes in total cost of production are presented in section 2 below.

A second estimate of the six-year change in cost efficiency is obtained by comparing, for the average herd, the cost of milk production derived from weighted cost functions estimated for the two study years. These results are presented in section 3.

Measures of cost efficiency are much less common than are studies of economic efficiency defined in terms of technical and allocative efficiency. However, there should be a relationship between the two. To test this further analysis of factor productivity change is performed using a Cobb-Douglas production function, with the results presented in section 4.

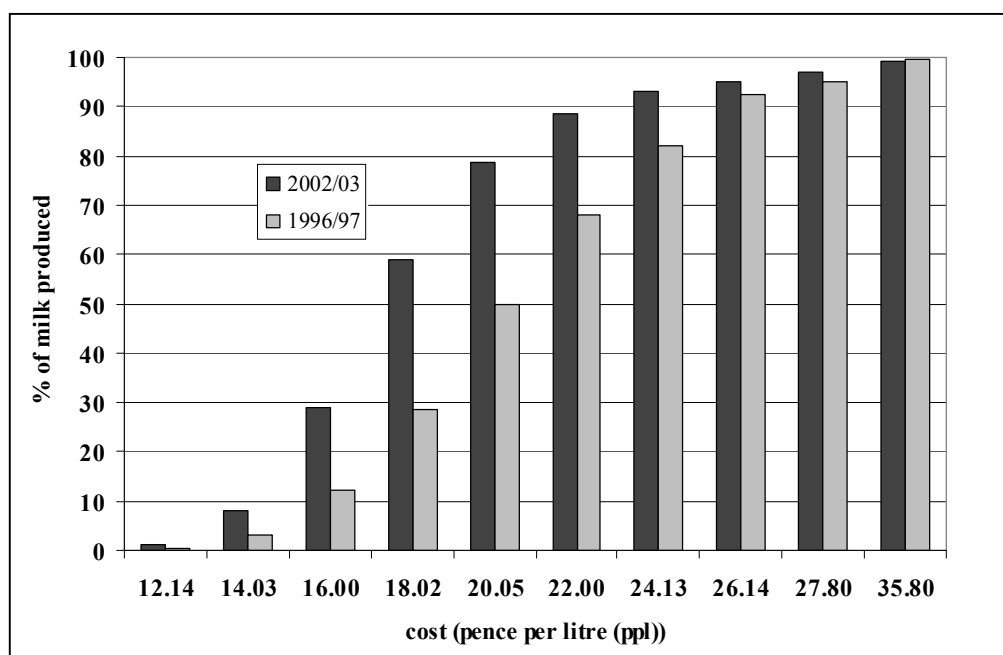
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The Implicit Cumulative Total Cost Function.

Crucial to the analysis are the enterprise cost principles applied in the surveys. These were the same for both studies and are set out in full detail in the two above cited reports. Many key costs have to be imputed, such as farmer and family members own labour, land rental costs for owned land and other resources, and the opportunity cost of owned milk quota. Details on these and other issues are presented in the above mentioned reports. Unpaid labour costs are a particularly important component of total cost, and the appropriate charges to make are a matter of some debate (RABDF, 2004). Clearly the amounts charged in the 2002/3 study differ from those in 1996/7, but by standardising the rates it is possible to compare what the cost efficiency gains would have been if labour costs had stayed the same.

The data collected in the survey enables a simple estimate to be made of the cumulative total cost function for all the milk produced in England and Wales in 2002/3. That is to say, by applying the appropriate population weight to each of the 369 sample producers' production, an estimate can be made of the total amount of milk that may have been produced at each sample producer's average total cost per litre. By ranking producers in ascending order of cost per litre, the cumulative amount or percentage of milk produced below any particular cost can be calculated and plotted. It has been possible to make the comparable calculation for the 377 producers in the 1996/97 survey, and to demonstrate the cost improvement over that six-year interval. The results are presented in Figure 1.

Figure 1. Implied cumulative percentage of E & W milk production by total costs per litre in 1966/7 and 2002/3.



The dark bars show the position in 2002/3, with an implied total production of 10.792 billion litres. Just less than 30% of that is estimated to have been produced at below 16 ppl and just under 60% at less than 18.02 ppl.² Given that the average weighted revenue was 18.12 ppl (comprising milk sales plus calf and miscellaneous revenue), this implies that over 40% of milk was produced at a loss.

It is important to note, from the light coloured bars for 1996/7, that there has been a process of cost-reducing progress over the last seven years. In 1996/97 only just over 10% of an implied 12.497 billion litres was produced at less than 16 ppl and around 28% at under 18 ppl. However, revenue per litre in that year was around 25 ppl, and well over 80% of milk was produced at a cost lower than that. Thus while there has been a significant improvement in cost efficiency it has not been anywhere near sufficient to counter the drop in milk prices and revenue. The progress itself has been primarily due to those producers staying in production exploiting economies of size by taking over the quota of down-sizing and less efficient producers, and through technical improvement.³

It is possible to infer from the data in the Figure approximately what the total cost of producing the relevant volumes of milk were in the two years. In 2002/3 the estimate is that the total cost of producing 10.792 billion litres of milk in England and Wales was £2,017 million.⁴ By comparison, in 1996/7 the cost of producing 12.497 billion litres was £2,571.4 billion. That suggests that it would have cost £2,221 million to produce 10.792 billion litres. In other words, the implication is that there was a 9.2% reduction in the cost of producing the aggregate output of 2002/3. That is a cost reduction of 1.5% per annum, even before allowing for the increases in hourly labour costs that occurred from 1996/7 to 2002/3, and the changes in other costs. If 2002/3 imputed labour cost rates were applied to the 1996/7 data it is estimated that it would have cost £2,998.2 million in that year to produce 12.497 billion litres of milk. Viewed from that standpoint, the industry achieved a 22.1% efficiency gain in the six-year interval to 2002/3, or just under 3.7% per annum.

That estimate of 3.5% is identical to the estimate obtained by Pierani and Rizzi (2003) for a sample of Italian specialist dairy farms. Their analysis was for 41 Italian dairy farms from 1980 to 1992, using FADN data, and they estimated the variable cost per litre to have fallen by 3.5% per year. Our estimate of a 22.1% reduction in all costs other than labour is not exactly comparable to change in variable cost, but labour costs are a high proportion of fixed costs, so that the comparability of estimates is worthy of note.

Comparing Cost Functions.

The basic cost function specification employed is one originally used by Burton (1995) and has been used in a number of studies since then ((Colman (Ed.) (2002)), Colman et al. (2005a)). It has the important property of being U-shaped in terms of all major explanatory variables, which are (a) herd size

2. The 0.02 in 18.02 arises because that is the average total cost for the farm with the nearest cost to 18 ppl.

3. Some efficient producers have also been leaving the industry, because they had more lucrative alternative enterprises or had nobody to take over the business when they retired (see Colman *et al.* 2002).

4. Note that that implies an average cost of production of 18.68ppl.

(cows), (b) yield per cow (*yield*), and (c) stocking rate on the forage area (*cow/ha*). That is to say there are diseconomies of size for any herd beyond a size, which is specific to each herd depending on its initial herd size, yield and stocking rate.

The 1996/7 function is estimated using the full sample of 377 farms. In estimating the 2002/3 function 30 holdings were dropped because their cost figures were seriously distorted by compensation and insurance payments resulting from the Foot and Mouth disease epidemic of 2001/2. The effect of this distortion was to convert a herd replacement cost into a herd replacement subsidy. However, data for 15 larger herds of over 200 cows was added to the 2002/3 data set from a supplementary source, because there were insufficient very large herds in the survey to adequately reflect the structure of the industry.

Examination of the results presented in Table 1 reveals that the overall explanatory power of the equation is high for both years for cross-sectional analysis, and that the variables are highly significant. With one exception namely the wage rate (*Wagert*) in 2002/3 all variables have the expected sign. There are some differences in size of coefficients on individual variables between the two years, but these are largely subtle as, for example, where the coefficient on *cow/ha* becomes more negative but that on *cow/ha2* becomes positive to offset this. The data is classified according to six regions, which is reflected in five regional dummy variables, with the constant reflecting the sixth region, which is the north plus north-east of England (NNE).

Table 1. England and Wales total milk cost functions 1996/7 and 2002/3.

Average cost (ppl)	1996/7		2002/3	
	Coefficient	T value	Coefficient	T value
Constant	70.18936	146.03	76.21549	112.39
Cow	-0.057201	-28.37	-0.03349	-22.80
Cow/ha	-6.56382	-44.27	-10.33732	-62.66
Cow/ha2	41.46681	37.76	88.05544	64.23
Cow2	0.0000395	9.56	-0.000038	-28.78
Cow2/ha	0.018503	17.19	0.032159	35.78
Yield	-0.01274	-82.73	-0.012437	-81.10
Yield2	9.47e ⁻⁷	69.49	8.28e ⁻⁷	69.28
Concpri	0.00547	4.16	0.010203	6.76
Wagert	0.066181	2.33	-0.350460	-5.94
dumwales	0.69760	9.00	2.20655	21.21
dumnorth-west	1.78740	23.55	2.48666	24.40
dumeast	6.26746	64.90	3.22300	26.41
dumsouth	2.21237	26.98	2.21712	18.50
dumsouth-west	1.31639	17.96	1.40470	13.42
	R ² = 0.63		R ² = 0.72	
Observations	377		354	

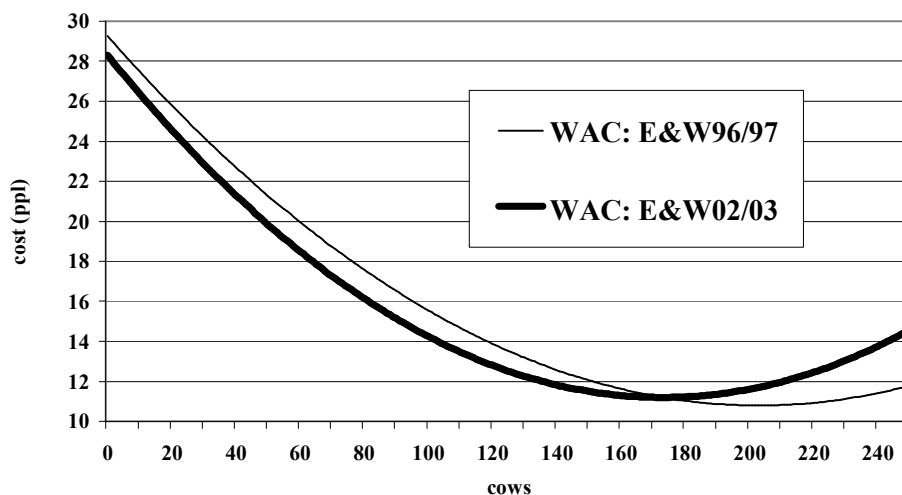
Figure 2 presents a graph of the two functions by herd size for the NNE region of England,⁵ with mean yield and forage area fixed at the average levels

for the England and Wales herd. It is immediately apparent that, at all herd sizes up to 174 cows, average total cost in 2002/3 was lower than in 1996/7. (It must be emphasised that these are in nominal prices of the two respective years. 1996/7 unit prices have not been adjusted to 2002/3 levels or vice-versa). However it is also apparent that the proportional cost reduction varies by herd size, which means that there is no unique way of comparing estimates of cost reduction derived from shifts in the cost function to the estimated cumulative 9.1% cost reduction derived for total England and Wales production in Section 2 above.

Evaluating the six-year cost reduction for the NNE for the average herd size in the two years (78 and 93 cows) provides an estimated cost reduction of 12.6%, from 19.19 ppl. to 16.76 ppl. A slightly higher figure of 14.1% is obtained as the production weighted cost reduction across all regions. This is clearly higher than the 9.1% calculated by method 1 above, which can be explained by the fact that the mean herd has, according to the cost functions, made more progress in cost-reduction than both smaller and larger herds. That the graph shows herds above 174 cows actually having increased average total cost per litre over the six-years is both surprising and unconvincing. Larger herds employ more hired labour, and it is repeatedly observed that a number of large herds have been quitting dairying because of high costs and poor returns (see Colman and Zhuang 2005b). Nevertheless it is doubtful if their performance has been as bad as these functions imply.

4. Comparing Production Functions.

Figure 2. Weighted average total cost of milk production in England and Wales 1996/7 and 2002/3.



A third way of approaching the measurement of progress in England and Wales milk production is to test for physical productivity gain. The two data

5. The intercepts for the other regions have to be adjusted according to the values of their respective dummy variables.

sets available permit this, with the full 2002/3 sample of 369 herds available for 1996/7— it was only distortions of the cost data that required 30 of these to be omitted from the cost function estimation. On the other hand, the data for the 15 supplementary large herds used in estimating the 2002/3 cost function do not include the necessary physical input data required for a production function, and these are omitted from this new analysis.

Cobb-Douglas production functions are estimated for the two study years. Total herd output in litres is expressed as a function of four input variables. These are (i) total labour hours applied during the year to the milk production enterprise (labhour), (ii) tonnes of concentrates fed to the herd (concq), (iii) forage hectares devoted to the dairy herd (ha), and (iv) the number of cows milked (cow) measured as an average of the numbers at the beginning and end of the milk quota year. The results of this weighted estimation are in Table 2, with estimation carried out by maximum likelihood.

Table 2. Weighted milk production functions, England and Wales, 1996/7 and 2002/3.

	Explanatory variables				Constant	Wald Chi Stat
	Ln(labhour)	Ln(concq)	Ln(ha)	Ln(cow)		
1996/97	0.00710 (2.71)	0.33312 (118.28)	-0.01326 (-4.01)	0.75713 (155.31)	8.26683 (532.68)	621194
2002/03	0.01860 (4.09)	0.26983 (92.54)	-0.06062 (-12.83)	0.89267 (140.44)	8.14466 (298.95)	368628
Mean of variables 1996/7	1460	128	45.3	77.9		
Mean of variables 2002/3	1294	173	50.3	86.5		

The estimated coefficients are all significant, mostly highly so, and the equations as a whole are highly significant according to the chi statistic. With the exception of the forage area variable the inputs attract positive signs. The negative sign on area is readily explained insofar as low stocking rates generally denote inefficiency. In both equations the sum of the coefficients exceeds one, denoting economies of size, which analysis suggests exists up to a certain optimum size (Colman, Farrar and Zhuang (2004, p. 37)). The sum of the coefficients for 1996/7 is 1.085 and for 2002/3 is 1.12.

An appropriate way of measuring productivity change is to compare what the average farm in 1996/7 (i.e. with the mean input values of that year) would have produced at the 1996/7 and 2002/3 coefficient values. In 1996/7 this turns out to be 530,688 litres, and in 2002/3 565,917, an estimated productivity increase of 6.6%. Clearly this is less than the cost efficiency gains calculated by the other two methods. However, it can be observed from the

values of the means that the input proportions changed between the two years, with a reduction in labour input (particularly when expressed per cow) offset by increases in concentrates per cow, with forage area per cow staying constant. If it is assumed that this change in input proportions reflects the substitution of cheaper for more expensive inputs then the increase in cost efficiency will exceed that in physical productivity.

It is also interesting to compare the estimates of productivity and cost efficiency gains with yields. The average weighted yields for the samples used in the production function estimation were 5909 litres in 1996/7 and 6816 in 2002/3; an increase of 15.3%. That estimated productivity increase is so much lower, at 6.6%, can be explained in terms of the commitment of a higher quantity of concentrate feed at higher cost to achieve the yield gains. It is thus not at all surprising that yields have increased by more than physical technical productivity.

Conclusions.

As with all economic sectors dairy farming in England and Wales has to strive to make annual efficiency gains. This paper has attempted to quantify various dimensions of those gains over a six-year interval using an identical sample of specialist dairy farms in 1996/7 and 2002/3. At the aggregate level it is estimated that total cost of producing England and Wales' total milk output in 2002/3 was 9.2% less than it would have been in 1996/7; that is a cost efficiency gain of 1.5% per annum. If there had been no increase in labour cost over this period it is calculated that the cost would have fallen by 22.1%, or by 3.5% per annum.

At the individual farm level a range of total cost reduction rates was calculated, depending on the specific herd size characteristics, using an estimated general cost function. For the average NNE herd of 93 cows in 2002/3 the reduction since 1996/7 in average total cost per litre was estimated at 12.6%, an annual cost efficiency gain of just over 1.9%. For England and Wales as a whole the comparable estimates (for the mean herd in each region) were 14.1% and 2.2%.

At the aggregate level the gains in cost efficiency are largely the result of structural change whereby a large proportion of the high cost herds leave the industry and only a modest proportion of those with low costs do likewise. At the individual herd level the cost efficiency gain is obtained by exploiting economies of size, and through changes in technical and allocative efficiency. According to an estimate made using production functions for 1996/7 and 2002/3, the herd with average inputs in 1996/7 would have increased milk output by 6.6% in 2002/3 without increasing inputs (1.1% per annum), while increasing average yield per cow by 15.3%. However, that average herd increased cow numbers and other inputs over the six years, thereby obtaining some cost reductions through economies of size, and obtaining an average cost efficiency gain of over nine percent; over 1.5% per annum. Continued progress of that order will be required to offset the expected downward pressure on producer milk prices from CAP milk regime reform.

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Biographical Notes

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REFEREED PAPER

**FARMERS' PERCEPTIONS OF THE SINGLE PAYMENT
SCHEME CROSS COMPLIANCE MEASURES**

James Jones

EU Member States are obliged to apply environmental cross compliance conditions to the Single Payment Scheme. The initial reaction of farmers in England to the proposed measures is explored using the results of a survey of 51 farmers. These were all members of self-help groups taking part in a Challenge Fund pilot project. Most farmers thought the conditions were unlikely to have any significant impact, but concern was expressed over conditions that may become more stringent in the future and those with existing compliance problems. Involvement in agri-environment schemes and organic farming did not appear to alter their perceptions as expected.

Key words: Single Payment; cross compliance; Common Agricultural Policy; environmental; measures

Introduction

The Common Agricultural Policy (CAP) reform of 2003 has redirected a large proportion of funds that were previously connected with production into a Single Payment (SP) with no specific link to production. The primary role of this new payment is 'to maintain income stability' but conditions are attached which provide a 'cross compliance' link to 'environmental, food safety and welfare standards' (Leguen de Lacroix 2004: p.7). Any infringement of the cross compliance conditions will result in a reduction in payment starting at 3% and rising to a maximum of 100% for deliberate breaches (DEFRA/RPA 2005a: p.38).

The attitude to cross compliance measures is bound to change as farmers become accustomed to both the measures themselves and the subsidy regime to which they are linked. This paper seeks to explore the reaction of farmers to the measures at the time of their introduction. The evidence for this is drawn principally from a survey of farmers participating in a pilot scheme designed to help communicate cross compliance conditions to farmer self-help groups. They are not 'typical' in that they were better informed than most other farmers, at the time, about what was entailed. However like all other farmers at that point in time they had no actual experience of cross compliance even though most of the measures adopted were existing legal requirements. Experience will doubtless alter some of their attitudes over time.

The cross compliance measures

The Single Payment Scheme (SPS) Implementing Legislation provides a fair amount of scope to Member States to apply the reforms in general in a manner that suits them best and cross compliance is no exception to this (CEU 2003; 2004). Member States opting to regionalise implementation of the reforms can apply separate regulations within each region. As a result there are separate regulations in England from those in use in other parts of the UK. These variations, as well as those across other countries in the EU-15, are explored by Farmer and Swales (2004).

Cross compliance conditions were identified under the introduction of the SPS regime as being distinct from other conditions (e.g. subsidy entitlement, land use, occupation periods, etc.) (DEFRA 2005(a); DEFRA/RPA 2005(e)). Set aside conditions were also treated separately (DEFRA/RPA 2005(d)). But there was some understandable confusion amongst farmers and their advisors, at the start of the scheme, as to why this should be and where cross compliance ended and general scheme compliance began. The confusion that surrounded many aspects of the SPS probably therefore affected the farmers' attitudes towards cross compliance to an extent.

The cross compliance requirements under the SPS in England are summarised in Table 1. They fall into three main areas: 'Permanent pasture', 'Good Agricultural and Environmental Conditions (GAEC)' and the 'Statutory Management Requirements (SMRs)'. The permanent pasture regulations are designed to control the conversion of permanent pasture into arable use. This is partially for environmental reasons and an Environmental Impact Assessment (EIA) may be required before consent is given. But its main purpose is to meet a EU requirement to prevent the area in permanent pasture falling below 90% of the area in 2003 (Regulation 796/2004, Article 3(2)). GAEC standards have been subdivided into two areas: 'Soil management and protection' and 'Maintenance of habitats and landscape features'. The GAEC requirements were partially built on existing legislation and codes of practice but some were entirely new. For example, the soil management requirements were mostly new (with the exception of GAEC 4 on the burning of crop residues which is based on legislation that has been in force since 1993). In 2005 farmers were merely expected to be aware of literature on soil management plans, but they knew that in 2006 they were going to have to draw-up their own soil conservation plans and to adopt these from 2007 onwards. The emphasis on soils within cross compliance has been backed by significant new interest in soil conservation in England (DEFRA 2004(d)) and a strong and clear direction to include soil conservation within the EU SPS legislation (CEU 2003: Annex IV).

Some requirements within the habitats and landscape section were not previously imposed on farmers outside agri-environment schemes. New requirements include GAEC 9 (overgrazing and unsuitable supplementary feeding), GAEC 12 (eligible land which is not in agricultural production) and GAEC 13 (stone walls). The protection of hedges, woods and watercourses by use of a buffer strip (GAEC 14) was a measure already widely in use within agri-environment schemes and in codes of practice linked to various assurance schemes. GAEC 15 (hedgerows) was not an entirely new measure but an extension of existing requirements on the maintenance of hedgerows to include additional rules covering their management.

The SMRs were to an extent already familiar to farmers as they were entirely built on existing legislation – as the term implies. Although SMR8a anticipated a change in legislation on sheep and goat identification requirements expected to take place in July 2005.

Table 1 A summary of cross-compliance requirements under the SPS in England for 2005.

Statutory Management Requirements (SMRs)

SMR 1	Wild birds - prohibited species and Special Protection Area compliance
SMR 2	Groundwater - permits and pollution by restricted substances
SMR 3	Sewage sludge - compliance with the sewage sludge regulations
SMR 4	Nitrate Vulnerable Zones (NVZs) – compliance with NVZ Action Programme Measures
SMR 5	Habitats - European Protected Species and Special Areas of Conservation (SCAs)
SMR 6	Pig/goat/sheep identification and registration
SMR 7/8	Cattle identification
SMR 8a	Sheep and goat identification (after July 2005)

Permanent pasture - rules on consent for conversion to arable

Good Agricultural and Environmental Condition (GAEC)

Soil management and protection

GAEC 1	General requirements - awareness of soil management guidance
GAEC 2	Post harvest management of land after combinable crops – maintaining cover to avoid soil erosion
GAEC 3	Waterlogged soil - prevention of mechanical field operations when soil is waterlogged
GAEC 4	Burning of crop residues - enforcement of the Crop Residues (Burning) Regulations

Maintenance of habitats and landscape features

GAEC 5	Environmental Impact Assessments (EIAs) – intensification permits on uncultivated land
GAEC 6	Sites of Special Scientific Interest (SSSIs) – restrictions in designated areas
GAEC 7	Scheduled Monuments - avoidance of damage to designated areas or features
GAEC 8	Public rights of way - keep within requirements to maintain and ensure access
GAEC 9	Overgrazing and unsuitable supplementary feeding - on prescribed and natural or semi-natural vegetation
GAEC 10	Heather and grass burning - to be kept within existing Regulations
GAEC 11	Control of weeds - on prescribed species and within the Weeds Act 1959
GAEC 12	Land which is not in agricultural production – minimum cutting or grazing requirements during year period
GAEC 13	Stone walls - prohibition of removal except to create gaps or for repairs/improvement
GAEC 14	Protection of hedgerows and watercourses - 2 metre protection zones i.e. ‘buffers’
GAEC 15	Hedgerows - to keep within 1997 Hedgerow Regulations and cutting restrictions
GAEC 16	Felling of trees - compliance with Forestry Act 1967 & the Felling of Trees Regulations which require licences to be issued
GAEC 17	Tree Preservation Orders (TPO's) - to abide by orders taken out by Local Authorities

Source: DEFRA/RPA (2005a).

The build-up and initial reaction to the introduction of cross compliance

The application of cross compliance to CAP farm support payments is a policy shift that had been anticipated for some time (EEA 2005). It has been a feature of US agricultural policy since the mid-1980's (Zulauf *et al.* 2003). In the mid-1990s environmental lobby groups were urging the inclusion of cross compliance within the CAP (Baldock and Mitchell 1995) and the implications of its adoption were being actively assessed (Holloway and Jones, 1997). The option to apply cross compliance conditions was in fact made available to EU Member States under the 1999 'Agenda 2000' reform of the CAP, but it was not taken up. Hence there had been plenty of opportunity for farmers to voice concern about the prospect of cross compliance well before it became a concrete reality in the 2003 CAP reform agreement (Gooch 1999; Gooch *et al.* 2001). The reaction to its inclusion in the SPS therefore has to be viewed in the context of it being a long awaited policy development promoted by environmental lobby groups and generally viewed with concern and trepidation by farmers and their representative bodies over some considerable time.

This affected the way that politicians tried to persuade farmers of the need for cross compliance under the SPS. The line taken has been one of appealing to the farmers' sense of reasonableness in accepting it as a kind of necessary evil and a *quid pro quo* to the benefit of receiving a new payment freed of the production conditions that had attached to previous payments. The Minister responsible for introducing cross compliance standards in England, Lord Whitty, warned farmers in a speech in January 2005 (just as they were being introduced) that they had to embrace them positively. 'I have heard some farmers complain that 'the Environmentalists have won'' he said. But then made it clear that in his view 'attaching subsidy to environmental outcomes is the only show in town that cuts any ice with the rest of the population' (Whitty 2005). The EU Commission had also earlier depicted the conditions as a necessary justification to go with the new payment albeit using somewhat less confrontational language (Fischler 2003).

The initial reaction by the farming press to the announcement of the proposed measures was negative and concentrated on the potential cost impact (Farmers' Weekly 2004(a)(b)(c); Agra-Europe 2003). This coincided with the launch of a consultation on them and doubtless there was a feeling that the proposals could be ameliorated if they were opposed robustly enough. But press coverage later in the summer of 2004 tended to be more balanced and emphasised the overlap with existing requirements (Allen 2004). There was relatively little press coverage towards the end of 2004 in the run up to their introduction on 1st January 2005. What coverage there was concentrated on implementation and the overlap with existing legislation and best practice. This reduction in interest and change in tone obviously reflected the fact that decisions had been made that would not now be altered. Perhaps also there was a realisation that some of the concerns had been overstated, and that some of the proposals had been successfully amended to lessen their impact (Harvey 2004).

The initial concerns of farming organisations were mainly aimed at whether the UK government would put their members at a competitive disadvantage with the over zealous application of cross compliance measures (Farmers Weekly 2004(c)) and to an extent they actively incited the negative press commentary with their press releases (CLA 2004). Their responses to the consultation show that their concerns focused on five main areas: soils, overgrazing, public rights of way, protection strips and permanent pasture preservation (DEFRA 2004(c)). Equal but opposing concerns were typically expressed by environmental organisations especially on the protective margins issue - which attracted 'the highest level of interest and comment of all the proposed measures' (p.10). The essential concern amongst farming organisations was not that it was necessarily a bad idea to have two metre uncultivated protective margins against environmentally sensitive boundary features, but that this should be paid for under agri-environment schemes and not added as a cross compliance requirement without attracting a specific payment (Gooch 2004).

The fact that this measure, which has now been implemented as GAEC 14 (DEFRA/RPA 2005a: p21), has not continued to generate such controversy can be attributed to two factors. Firstly the measures were altered to lessen the impact and this effectively removed it altogether in many cases. The regulation was altered so that the two-metre margin was to be measured from the centre of the feature rather than the edge. This meant that hedges over 4 metres in width had no requirement to create a buffer strip next to them at all. It was also decided to create a complete exemption from the need to create buffer strips in fields of less than two hectares. Secondly it was decided to allow an overlap with existing buffer strips for those in existing agri-environment schemes without (as yet) affecting their payment rates.

Perception of participants in the Challenge Fund Farmer Self-help Groups Project

This paper reports on the perceptions of 51 farmers drawn from 5 self-help groups established under the Challenge Fund. These farmers benefited from up to three meetings at which the cross compliance requirements were explained in some detail, although some farmers felt not all their questions were fully addressed (partly because the regulations were still in the process of being drawn-up when some of these meetings took place). This and other operational issues are described more fully in Jones and Tate (2005). The groups were largely drawn from an existing network of contacts by the agricultural colleges that organised them. But the group drawn together by Harper Adams was partly attracted by a newspaper advertisement and the Royal Agricultural College group was composed of tenants of the Gloucestershire County Council Farms Estate. These farms comprise small 'starter holdings' with an emphasis on dairy farming (although in practice most of these farmers had increased the area farmed by taking on additional land). They are not typical of the farming in the area as a whole.

The groups represent a fair geographical spread but notably do not include any hill farmers or groups from the North of England or the far South West. The Harper Adams catchment area contained both the intensive arable and

dairy farms of the Shropshire Plain as well as the mixed farms on the Welsh border. The Gloucestershire County Farms are mostly located in the Severn Vale but extend right to the borders of the county of Gloucestershire and even outside it into Warwickshire. The Plumpton College farmers were from the Weald and the South Downs area of East Sussex representing a mixture of soil types and farming. The remaining two areas were both in East Anglia offering a broad coverage of the region from Otley College near Ipswich to the South and Easton College near Norwich to the North. Inevitably the emphasis in this region was on arable farming but in many cases this also included pigs and some cattle farming as well as in one case fruit.

Table 2 shows that the sample of farmers who completed the questionnaires had a bias towards larger farm sizes (despite the inclusion of the Gloucestershire Farm Estate tenants). The range in size was from 10 to 860 hectares. The spread of farm types took in a good range of livestock and arable farming (as shown by the numbers under each of the categories in Table 5) but it is difficult to be precise about how this matches-up against national statistics because of the need to collect a large amount of detailed information to classify farms in the same way. However dairying and mixed farming were probably over-represented in the sample compared with England as a whole

Table 2 Farm sizes in the farmer self-help groups compared with England as a whole.

Size in ha	England n = 192,877	Survey n = 51
< 20	61.7%	2.0%
>20 <=50	13.3%	7.8%
>50 <=100	11.1%	15.7%
>100	13.9%	74.5%
Average	55.6	187.9

Source: DEFRA (2005).

and exclusively arable, and beef and sheep farms under-represented. Absent from the sample were hill farmers and 'others' (i.e. farming that falls outside the main categories). Although it is just possible that some of the sample might be defined in official statistics as falling within the 'others' category as a result of having equine enterprises of a significant scale.

Overall the sample size is too small with bias towards certain farm types and geographical regions for it to be considered representative of English farms and farmers. The potential for bias increases for the cross compliance conditions that are not applicable to all farms. However, the responses do provide some indication of farmer perception at this initial stage of implementation, and the survey is sufficiently broad to draw some reasonably general conclusions.

Perception scores

The questionnaire asked farmers about their level of concern about the cross compliance measures. Table 3 shows the percentage of the sample for each measure which was 'not applicable'. It can be seen that certain measures such as GAEC 10 (grass and heather burning), which is aimed at upland farmers, were not an issue to most participating farmers in the survey. GAEC 13 (stone walls) is another example of a measure that is only likely to be an issue in certain regions (although stone walls are reasonably prevalent in Gloucestershire and could be found in isolated cases on farms in the other

Table 3 Perception of cross compliance measures – ranked percentage of 'not applicable' scores.

Measure	% stating measure was 'not applicable'.
GAEC10 Grass burning	94%
GAEC13 Stone walls	88%
GAEC6 SSSIs	77%
GAEC7 Scheduled Monuments	76%
SMR3 Sewage sludge	68%
GAEC4 Straw burning	60%
SMR6 Pig/goat/sheep identification	55%
GAEC12 Land not wholly in agric.	49%
SMR8 Cattle ID	47%
SMR7 Cattle passports	46%
GAEC17 Tree PO's	40%
GAEC9 Overgrazing and suppl. feed	39%
SMR4 NVZs	33%
GAEC16 Felling trees	20%
GAEC2 Post harvest mgt of stubbles	13%
SMR5 Habitats (SACs)	11%
Permanent pasture rules	11%
GAEC5 EIAs	10%
GAEC8 Rights of way	10%
SMR2 Groundwater	8%
GAEC14 Buffer strips	4%
SMR1 Wild birds	4%
GAEC3 Saturated soil	4%
GAEC11 Control of weeds	4%
GAEC15 Hedge cutting	2%
GAEC1 Soil management plans	0%

parts of the country covered by the survey). Measures that depend on special designations are by definition limited in their applicability. Designations for SSSIs and Scheduled Monuments are rare but the NVZ designated area is now very extensive and this is reflected in the applicability scores. Measures directed towards certain types of farming are also obviously limited in their applicability. Thus GAEC 4 (straw burning) only applies to farms with combinable crops and SMRs 6, 7 and 8 only apply to farms where livestock are kept.

Low scores, representing widespread application, were recorded for the soil management measures. GAEC 1 is a universal requirement (although the Gloucestershire farmers were unable to record any score for this measure because they were surveyed just before the final regulations were released and at this stage the measure was not included). GAEC 15 on hedge cutting and management, GAEC 11 on weed control, SMR1 on wild birds and the contentious GAEC 14 requirement for two metre protection zones, were all of wide applicability.

The perception scores from those farmers who were (at least to some extent) affected by the measures are given in Table 4, assessed on a four point Lickert scale from 'negligible' (1) to 'major' (4). The results are not entirely predictable but provide interesting insights. On the face of it the two highest scores for SMR6 on the identification of pigs, goats and sheep and GAEC 1 (the requirement to be aware of the soil management plan literature) seem rather puzzling. SMR6 simply reinforced existing measures and GAEC 1 only required farmers (in 2005) to keep a copy of the literature and be aware of it, but not actually to apply it. However these can be seen as 'forward thinking' concerns. Sheep farmers in particular were concerned that traceability requirements might become as demanding as those in force for cattle and would thus be very onerous. Similarly, with GAEC 1, farmers were aware that whilst the measure initially was not too demanding the requirements would escalate from just an awareness of the literature to the creation of a soil management plan and finally to its implementation.

In some ways it is surprising to see measures that simply provide an extra sanction in enforcing existing legislation with a high impact score. Examples include SMR4 (NVZs), GAEC 6 (SSSIs), GAEC 8 (Rights of Way) and SMR 8 (cattle identification). The reason for this may be because these are all areas where compliance is contentious and/or unsatisfactory. In relation to GAEC 6, for example, it has been estimated that only just over 57% of the area in SSSIs was in 'favourable condition' in 2003 (CJC Consulting 2004: p. vii). In relation to GAEC 8, the Ramblers' Association estimate that a third of rights of way are blocked or otherwise obstructed (representing some 43,000 miles) in England and Wales (Ramblers' Association 2005).

One might expect areas that were not part of existing legislation would be of greater concern. Amongst these the soil management measures (GAEC 2 and 3) had highest impact scores. GAEC 14 (2 metre buffer zones) caused particular controversy prior to implementation (as described above). However, these average scores indicated some concern but rather less than for a number of other measures. Interestingly GAEC 12 (the requirements for keeping land not wholly in agricultural production in a state where it could be returned to agriculture) was seen as relatively low impact. This could reflect the farmers'

circumstances. However the Regulatory Impact Assessment (RIA) did point out that ‘The level of management required is not very onerous.’ (DEFRA 2004(b): p.49), it also suggested that ‘Overall costs would not be expected to be substantial...’ (p.50). This might be reflected in the low scores.

The lowest scores apply to measures that, despite being restrictive, have been in force for some time and farmers are both well aware of them and generally compliant. Examples of this include the ban on straw burning (GAEC 4), tree felling licence requirements (GAEC 16) and the special

Table 4 Perception of cross compliance measures – ranked scores

Measures	Score*
SMR6 Pig/goat/sheep identification	2.70
GAEC1 Soil management plans	2.61
Permanent pasture rules	2.58
SMR4 NVZs	2.42
GAEC3 Saturated soil	2.33
GAEC6 SSSIs	2.27
SMR8 Cattle ID	2.19
GAEC2 Post harvest mgt. of stubbles	2.17
GAEC8 Rights of way	2.16
GAEC14 Buffer strips	2.15
SMR7 Cattle passports	2.15
GAEC11 Control of weeds	2.14
SMR2 Groundwater	2.13
GAEC15 Hedge cutting	2.10
GAEC7 Scheduled Monuments	2.08
SMR5 Habitats (SACs)	2.00
GAEC9 Overgrazing and suppl. feed	2.00
GAEC13 Stone walls	2.00
GAEC5 EIAs	1.91
SMR1 Wild birds	1.88
SMR3 Sewage sludge	1.75
GAEC12 Land not wholly in agric.	1.68
GAEC10 Grass burning	1.67
GAEC17 Tree PO's	1.64
GAEC16 Felling trees	1.60
GAEC4 Straw burning	1.35

* Score between 1 and 4: 1 indicates negligible impact, 4 major impact.

*Table 5 Perception of cross-compliance measures – score by farm type**

Measures	Farm type					
	Arable	Arable & pigs	Mixed	Dairy & arable	Dairy	Beef & sheep
	n=13	n=5	n=11	n=6	n=10	n=4
	Score	Score	Score	Score	Score	Score
	(1-4)	(1-4)	(1-4)	(1-4)	(1-4)	(1-4)
SMR1 Wild Birds	2.4	1.2	1.8	2.0	1.6	1.8
SMR2 Groundwater	2.4	2.2	1.9	2.0	2.3	1.7
SMR3 Sewage sludge	1.7	2.0	2.5	1.3	1.0	2.0
SMR4 NVZs	2.4	3.2	2.6	2.5	2.0	1.7
SMR5 Habitats (SACs)	2.5	2.4	1.6	2.0	1.6	1.5
SMR6 Pig/goat/sheep identification	2.0	2.6	2.8	1.7	3.0	3.7
SMR7 Cattle passports	2.0	n/a	2.4	2.2	1.8	2.7
SMR8 Cattle ID	2.0	n/a	2.3	2.2	2.0	2.7
Permanent pasture rules	2.3	2.5	2.4	3.0	2.8	3.0
GAEC1 Soil management plans	2.7	2.4	2.6	2.3	2.5	4.0
GAEC2 Post harvest mgt of stubbles	2.6	2.2	1.9	1.5	2.0	n/a
GAEC3 Saturated soil	2.2	2.8	2.1	2.2	2.4	3.0
GAEC4 Straw burning	1.3	1.5	1.5	1.3	1.0	n/a
GAEC5 EIAs	2.2	2.5	1.8	1.7	1.7	2.0
GAEC6 SSSIs	3.0	n/a	1.5	2.5	1.0	1.0
GAEC7 Scheduled monuments	3.0	n/a	1.0	1.8	1.0	3.0
GAEC8 Rights of way	2.7	2.4	2.0	1.9	1.7	2.5
GAEC9 Overgrazing and suppl. feed	2.3	1.0	2.4	2.2	1.4	2.7
GAEC10 Grass burning	2.0	n/a	n/a	n/a	1.0	n/a
GAEC11 Control of weeds	2.3	2.8	2.3	1.6	1.7	2.5
GAEC12 Land not wholly in agric.	1.9	2.0	1.4	1.3	1.0	n/a
GAEC13 Stone walls	2.5	n/a	1.0	2.0	1.0	3.0
GAEC14 Buffer strips	2.5	2.6	1.8	2.2	1.7	2.3
GAEC15 Hedge cutting	2.5	2.6	1.9	1.8	1.4	2.3
GAEC16 Felling Trees	1.8	2.4	1.2	1.6	1.3	1.3
GAEC17 Tree POs	1.9	2.2	1.3	1.3	1.0	1.5

* Score between 1 and 4: 1 indicates negligible impact

conditions that apply with Tree Preservation Orders (GAEC 17). Grass

burning restrictions (GAEC 10) and Sewage Sludge Regulation compliance (SMR 3) are both well understood and accepted but were also recorded as 'not

Table 6 Perception of cross compliance measures – score by organic farming and agri-environment scheme participation

Measures	Organic n = 4 Score (1 to 4)	Non- n = 45 Score (1 to 4)	In AES n = 18 Score (1 to 4)	Not in AES n = 22 Score (1 to 4)
SMR1 Wild birds	1.7	1.9	1.7	1.8
SMR2 Groundwater	2.3	2.1	2.0	2.1
SMR3 Sewage sludge	1.0	1.8	2.0	1.5
SMR4 NVZs	2.5	2.4	2.5	2.3
SMR5 Habitats (SACs)	2.3	1.9	2.2	1.8
SMR6 Pig/goat/sheep identification	2.5	2.8	3.1	2.8
SMR7 Cattle passports	2.0	2.2	2.4	1.8
SMR8 Cattle ID	2.0	2.2	2.3	2.0
Permanent pasture rules	3.0	2.5	2.6	2.8
GAEC1 Soil management plans	2.7	2.6	2.7	2.6
GAEC2 Post harvest mgt. of stubbles	1.8	2.2	2.2	1.9
GAEC3 Saturated soil	2.8	2.3	2.3	2.3
GAEC4 Straw burning	2.0	1.3	1.4	1.0
GAEC5 EIAs	2.3	1.9	1.8	1.7
GAEC6 SSSIs	3.0	1.9	2.4	2.5
GAEC7 Scheduled Monuments	2.3	2.0	2.2	1.8
GAEC8 Rights of way	2.8	2.1	2.5	1.8
GAEC9 Overgrazing and suppl. feed	1.7	2.0	2.6	1.8
GAEC10 Grass burning	3.0	1.0	3.0	1.0
GAEC11 Control of weeds	2.0	2.2	2.2	2.0
GAEC12 Land not wholly in agric.	2.0	1.7	1.9	1.4
GAEC13 Stone walls	3.0	1.8	3.0	1.0
GAEC14 Buffer strips	2.0	2.2	2.1	1.9
GAEC15 Hedge cutting	1.8	2.1	2.1	1.8
GAEC16 Felling trees	1.8	1.6	1.5	1.6
GAEC17 Tree PO's	1.7	1.7	1.6	1.4

* Score between 1 and 4: 1 indicates negligible impact, 4 major impact.

applicable' by most of the farmers in the sample. The slightly higher levels of concern about these long-established requirements come from just a few responses and therefore have to be treated with caution.

The influence of the farm type on perceptions

Table 5 shows average scores by farm type; the numbers involved are small so it would be wrong to draw strong conclusions: the largest farm type (arable) amounts to only 13 farmers and the smallest (beef and sheep farmers) to only 4. Nevertheless, there are some predictable outcomes as well as some surprises. Predictably, pig farmers are most concerned about NVZ regulations (SMR 4) because of the restrictions imposed on the disposal of slurry. Unsurprisingly, arable farmers are most concerned about post-harvest management of stubbles (GAEC 2), and dairy and arable farmers are most concerned about permanent pasture rules. The high level of concern by beef and sheep farmers about sheep identification (SMR 6) also comes as no surprise.

However there are some responses that seem to correspond rather less well to what one might expect. The very high level of concern by beef and sheep farmers about soil management guidance (GAEC 1) is puzzling, their relative lack of land cultivation might be expected to make this only a low level concern. The relatively high level of concern expressed by arable farmers about the regulations relating to Scheduled Monuments is to be expected because of the dangers of disturbing archaeological features by cultivation. But again it seems odd that beef and sheep farmers should share the same level of concern.

There are some scores that one might have expected to be higher for certain farm types. For instance, it is a little surprising that dairy farmers showed little more concern about groundwater pollution than other farmers. It is also surprising that arable farmers did not appear to be more concerned than grassland farmers about the impact of two metre buffer strips (GAEC 14) given that these cannot be cropped but can be grazed or mowed.

Perception scores amongst organic farmers and those in agri-environment schemes

The number of organic farmers was very small, at only 4. Their average scores (shown in Table 6) do not stand out as being all that different from the non-organic farmers. There are some differences such as the higher levels of concern about GAEC 6 (abiding by SSSI restrictions) and GAEC 8 (the maintenance of rights of way). But there is little to suggest that this is connected with their organic status. The lower level of concern about SMR 3 on Sewage Sludge could be related to the over-riding influence of organic farming protocols. But the sample is far too small to make too many judgements of that kind.

The agri-environment scheme (AES) participants were only slightly fewer in number than the non-participants (amongst those that answered this question). The results (also given in Table 6) were not quite what one might

expect. Scheme participants actually seemed to be more concerned than non-participants under circumstances where it might be assumed that the opposite would be true, i.e. where scheme rules are likely to have an over-riding effect. Examples of this include the higher scores for SMR 3 (Sewage Sludge regulations), SMR 4 (NVZ regulations), SMR 5 (Habitats), GAEC 7 (Scheduled Monument protection), GAEC 9 (over grazing and use of supplementary feed), GAEC 9 (grass and heather burning) and GAEC 12 (grazing and cutting of land not wholly in agricultural production). The slightly higher score under GAEC 14 (buffer strips) might seem surprising but could be explained by a concern that this management prescription, which is popular within agri-environment schemes, might become an obligation rather than the subject of a payment.

Conclusions

The application of cross compliance measures to the SPS represents a major change in both the CAP and in the way in which EU environmental policy affects farmers. In England the farming media and farmers organisations were, at least in the early stages of consultation, quite negative towards the proposed cross compliance conditions. The assessment of a few relatively well-informed farmers in the self-help groups offered a far more measured reaction but within which there were significant levels of concern with respect to some of the measures. The greatest concerns were expressed in those measures that could readily be made more demanding. The acceptance by most farmers that they could come to terms with these measures without suffering a large adverse impact on their business is not too surprising given that so many are based on existing requirements. It was notable that the highest levels of concern regarding existing requirements were with respect to measures experiencing compliance difficulties and/or were onerous to apply.

It will be interesting to see whether farmer's concerns over fears of creeping regulation, in areas such as soil management requirements and sheep identification, prove to be well founded. It will also be instructive to see whether areas of legislation, such as public rights of way and SSSIs, where significant compliance problems existed before their inclusion in SPS cross compliance also become areas of conflict under the scheme and whether compliance improves. The rationale of linking compliance to payments made under the SP, instead of it just comprising a legislative requirement without any overt link with public support, might improve attitudes as well as compliance rates.

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REFEREED PAPER

**MAXIMISING FARM BUSINESS PROFITABILITY IN THE
NEW ENERGY ERA**

Ralph Blaney

Modern agricultural production is reliant on oil and gas. As key inputs, farm managers should take an interest in their prospects. Over recent years oil and gas have become increasingly expensive as the world enters a new energy era. Farm managers can profit by considering the implications.

Key words: energy costs, bio-fuels, land use, relative prices.

Introduction

It is a truism that in order to be successful a farm business must plan for the future. This planning can take various forms, and at its most fundamental includes decisions on crop rotations, stock replacement and capital investments. When making such decisions farm managers will consider the associated risks. Farm managers have become accustomed to dealing with risks related to output prices, which can be reduced by entering long-term supply contracts or undertaking financial risk management strategies. Input price risks have received less attention.

Current usage of fossil fuels in farming for heat, power and transportation is environmentally damaging due to the release of greenhouse gases into the atmosphere upon combustion. However, the two most widely used fossil fuels, oil and gas, are important inputs for UK agriculture, both directly and indirectly (for agri-chemicals and plastics). Oil is the most versatile of energy sources and even though its use as a fuel has declined slightly due to improved efficiency, it still accounts for over a third of the energy used in farming (DEFRA 2005).

The price of oil has risen rapidly over the last few years. Nevertheless, a number of energy experts now agree that its price will continue to trend upwards over the foreseeable future (Almeida and Silva 2005). The underlying reason for this rise, they contend, is that we are nearing the maximum in global oil production. Shortly it will not be possible to get oil out of the ground at the rate needed to meet demand and (perhaps as soon as a couple of years from now) oil production will reach a transitory plateau. Production will then tail-off over six or seven decades. Many oil producing countries are extracting less oil each year as reserves run dry, including the UK (Energy Information Administration 2005), already the availability of the best quality oil is in decline. The stalling of production growth also means that spare capacity is substantially reduced, leading to a greater risk of oil price spikes as a result of disruptions due to accidents, terrorism or natural disasters.

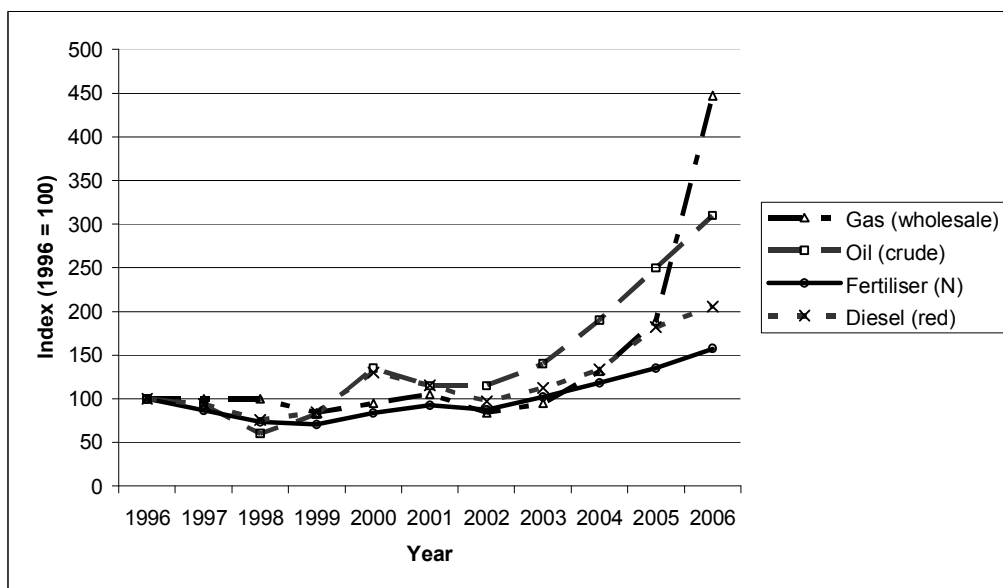
The price of gas is linked to the price of oil, so as oil increases in price so will gas. In addition, UK gas supplies are also in sharp decline and demand will have to be met by imports (if available at the scale needed), further adding to the cost. Gas-fired power stations provide a third of UK electricity, therefore, not only will oil prices rise, so will the cost of most energy sources.

Farm managers would be prudent to consider that the era of cheap energy has now passed.

The impact on agriculture

Over time the mounting price of energy will have far-ranging consequences, some of which will be felt by agriculture. Agriculture is dependent on oil as a fuel for tractors, harvesters and other farm vehicles, and it is used to produce plastics, mechanical lubricants, tyres and pesticides, as well as for heating. Oil is also essential in the construction and the repair of equipment and the infrastructure needed to facilitate the agricultural industry, including farm machinery, processing facilities, storage, lorries and ships. Within agriculture gas is mainly used in nitrogen fertiliser production, but also as a heating fuel. The end of stable energy prices in 2003 due to emerging supply constraints and the consequent impact on input prices is unambiguous (see Figure 1).

Figure 1. Rising energy costs feed through to input prices (data for 2006 are based on available data for the first quarter of the year).



The current tax relief on fuels used in agriculture means that although their prices will continue to remain below fully taxed fuels, any rise in energy costs will result in proportionately higher price increases. The amount by which input costs increase will depend upon how great a component energy is, and how high oil and gas (and subsequently electricity) prices go. Future prices are almost impossible to predict with any accuracy, and the task gets more difficult further into the future. An analysis which is being used by the Canadian Imperial Bank of Commerce (CIBC) estimates an oil price of \$100 a barrel by the end of 2007 (Maich 2005). This equates to almost fifty pence per litre for red diesel. However, this assumes that everything works smoothly, an alternative scenario is that prices will spike as a result of bottlenecks, terrorist

attacks, or political turmoil, in which case oil might spiral to around double that price. Gas prices are likely to follow oil prices, but whether increases are greater or smaller than those of oil depends on many factors and is therefore unclear. However, in the UK it is possible that in the near future gas prices will rise sharply irrespective of the oil price. The direct impact of oil price rises on current farm business profitability (net margin per hectare/head) are shown in Table 1. It should be noted, though, that these figures do not include the indirect impacts (as the higher oil price feeds through to most other inputs), nor does it assume any management changes as a result of the higher prices, or increases in output prices.

Table 1. Net margins (£ per hectare/head for various oil prices).

Oil price (per barrel of crude) \$	Milling winter wheat £	Sugar beet £	Potato (ware) £	Dairy £	Lowland beef sucklers £	Lowland sheep £
30	50	250	400	80	10	5
50	37	228	353	73	3	4
70	24	206	306	66	-4	3
100	-2	162	212	52	-18	1
160	-41	96	71	31	-39	-2
220	-80	30	-70	10	-60	-5

Enterprise margins have in effect already declined as a result of the decoupling of support, and as the price of oil rises these margins will be put under further pressure. Those farm businesses most exposed to the oil price increases are likely to experience the greatest reduction in profitability. Generally, livestock enterprises should be in a slightly better position than arable enterprises. As a percentage of total costs, fuel accounts for two to four percent in dairy and lowland sheep production, but five percent in cereals production. Based on the CIBC oil price estimate, by 2008 fuel could become the largest single cost of production for cereal producers if other costs are held constant (in reality it would most probably take longer for fuel to become the largest cost item since higher energy costs would also feed through into other inputs). However, as Table 1 indicates, livestock producers already suffering low levels of profitability would experience losses at similar oil prices as arable producers.

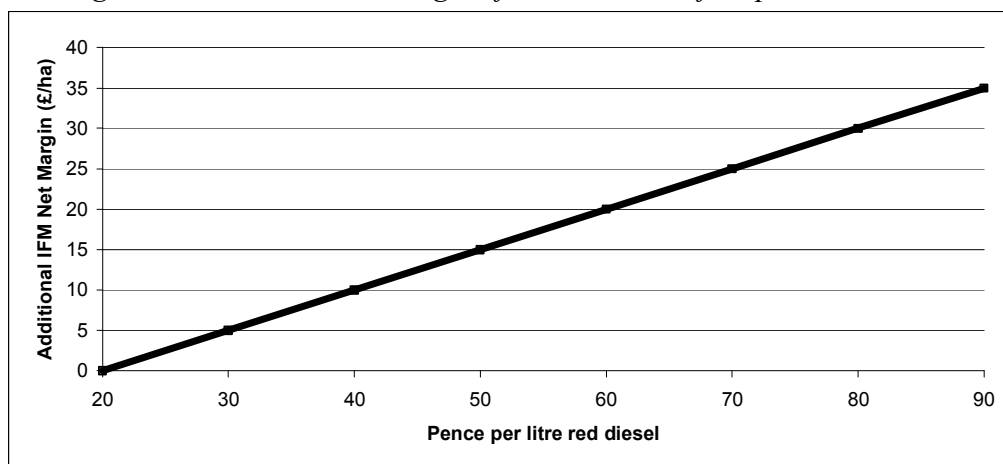
Remote areas will be hit hard since they will not only be subject to higher fuel costs, around ten percent higher than in central locations, but will also pay proportionately more for many other inputs due to the higher transportation costs. Overall, the agricultural industry will adapt to a situation of high-priced energy, but for individual farm managers being aware of the risk in advance and being pro-active in managing it would certainly be worthwhile.

Farm management responses

The new energy era will progressively transform the basis for current calculations of profitability, but responding to the changing circumstances may not always be unproblematic. For instance, higher oil prices will provide an incentive to move away from the use of fuel-inefficient machinery. However, replacement schedules might not coincide with the desire to purchase more fuel-efficient machines. In addition, the existing fuel-inefficient machinery is likely to experience a greater depreciation in resale value. As a second-best action to cope with the increased energy costs of running existing farm machinery, farm managers could look for ways to reduce field passes (such as combining field operations). Also, energy efficiency can be maximised by use of high gears for low-power operations, and using non-powered implements where practical. The most energy-intensive operations are silage-making, tillage operations and slurry handling. Enhanced maintenance of equipment would also become more important. For example, dull knives in a forage harvester can increase power requirements and fuel use up to thirty percent (CAEEDAC 2002). On the other hand, increased maintenance may well require employing additional labour.

A simple step that all farm managers can take is to engage in farm benchmarking. Energy use will vary greatly between similar farms, and by benchmarking energy use possible areas for improvement can be identified. For example annual electricity consumption on dairy farms can vary from 200 to 400 kilowatt hours per cow, while savings in electricity use can be made by insulating hot water tanks and installing low-energy light bulbs (MDC 2005). Farm managers can obtain energy saving tips from a number of sources. Energy efficiency publications are available free or for a small fee from organisations such as the Farm Energy Centre and the Carbon Trust (who have published an 'Energy saving guide for agriculture and horticulture').

Figure 2. Additional net margin of IFM wheat as fuel prices increase.



There do appear to be some clear strategies, though. Increased fuel and agri-chemical costs make the adoption of precision agriculture and Integrated Farm Management (IFM) more economically viable (Scottish Natural

Heritage 2005). Direct drilling, for instance, uses only around a fifth of the fuel used for ploughing. Figure 2 shows the difference in profitability between IFM and conventional production of milling wheat. At low diesel prices of less than 20 pence per litre there is little or no difference in net profit per hectare between IFM and conventional production. However, as the price of fuel (and related inputs) increases so do the financial benefits of IFM. At prices of 90 pence per litre red diesel a farm manager who has adopted IFM could make on average around £35 per hectare greater profit than a conventional counterpart. This could mean the difference between returning an overall profit or loss. These calculations assume a milling wheat price of £86/t, and yields of 7.74t/ha and 8.6t/ha respectively for IFM and conventional production. At a red diesel price of 30 pence per litre the variable costs are £264/ha for IFM and £314/ha for conventional production, with fixed costs of £416/ha and £445/ha respectively.

The extent to which production processes should change will depend upon the relative cost of the various technologies and inputs used in production. For example, a significant rise in oil prices will mean that in some instances biological control of pests should become a more profitable alternative to pesticide use. With regard to labour substituting for other factors of production, the changes are likely to be minimal. Although many fruit and vegetable crops are already harvested by hand using casual labour, for labour to replace machinery in most other tasks (e.g. knapsack spraying instead of using a propelled sprayer) fuel prices would need to rise by over fifty times more than envisaged. The only example of a radical switch away from machinery and agri-chemicals to labour is Cuba, where agriculture's de-industrialisation from a level of inputs higher than the USA in 1989 to a low input organic/semi-organic system a decade later occurred due to an actual scarcity of oil. Such an unavailability of oil in the UK is not forecast in the foreseeable future. There may, though, be opportunities for greater uses of horse power for some tasks on smaller holdings (such as harrowing, rolling and carting). Although working horses in UK agriculture are rare (there is at least one commercial farm in England run mainly on horse power), their application in forestry is more widespread as a result of increasing use over the last two decades. There is very little data on the comparative costs of horse power. A study undertaken on short-haul delivery work found that a pair of horses and a cart cost the same to operate as a lorry (Webster 1985). As fuel prices rise horses should become more competitive.

What could be of greater importance is the impact that higher transportation costs have on the type of crops grown. At present various foods, some of which could be grown in the UK, are shipped or flown here from elsewhere in the world, sometimes over very considerable distances. As transport costs rise, these foods will become more expensive, especially those moved by air. For example, at the beginning of this decade fruit and vegetables from Africa cost around £1,000 per tonne to airfreight to the UK (Brown 2005), whilst those from the Far East cost almost £800 per tonne (Department for Transport 2000). By 2008 the costs are set to increase to at least £1,250 and £1,000 per tonne respectively. This is equivalent to a ten percent increase in the total purchase price paid by the UK supermarkets

(Brown 2005). Locally grown alternatives might then compete with these imports, so long as producers here minimise energy inputs in production. A relative rise in the retail price of exotic fruits and vegetables may also result in a minor switch in consumption by the public back towards those traditionally grown in the UK. Thus, opportunities may arise to undertake both glasshouse and outdoor production of fruits, vegetables and salad crops.

Transport costs within the UK would also increase, encouraging more localised processing and distribution of food products where this is practical. This is because the economies of scale associated with centralised (i.e. fewer, but larger) processing facilities disappear as transport costs rise. This change may also impact on regional demand patterns. For agriculture, which is largely involved in the production of commodities with a low value-to-weight ratio, regional specialisation and trade works best when goods can be moved at little cost. In the longer-term, high transport costs may result in a move away from regional specialisation. For example, in England the practice of hauling large quantities of straw and feeds from east to west could become uneconomic at the greatest distances if road fuel prices rise substantially, thus encouraging more arable production in the west. However, because of the large investment costs, there is unlikely to be any financial advantage to individual producers in switching to a mixed farming system in the next decade or so, apart from those converting to organic production.

More immediate opportunities include direct selling from farms. Transport costs account for around three percent of the retail price of food in supermarkets (UK Social Investment Forum 2004; Smith *et al.* 2005), but this varies depending on the value of the product as well as distance travelled and unit travel cost (the latter largely determined by the size and weight of the product). As higher oil prices feed through to distribution costs the price of supermarket food should rise relative to that sold directly from the farm. Supermarkets may adapt their distribution systems to reduce the impact of transport costs, but due to the nature of the prevailing logistical management approach it is unlikely that major changes could be made in the short-term. So, the cost advantages for farm shops could exist for some time, however the shortcoming is that the potential customer base for farm shops may be very much determined by location. A recent study for the Department for Environment, Food and Rural Affairs (Smith *et al.* 2005) noted that a growth in business for local producers and retailers could increase energy consumption and transport costs since more car journeys would need to be made. Cars are not a very cost effective means of moving food (compared to a fully laden heavy goods vehicle), and supermarkets allow shoppers to purchase all of their food requirements from just one location. At present it may be that many (or even most) purchases from farm shops result from a specific journey to the farm shop. However, where shoppers can incorporate a stop at a farm shop to purchase produce as part of an existing journey the associated transport costs become negligible. Therefore, for farm businesses in prime locations, e.g. very close to major roads near towns or on rural commuter routes, the cost advantage over supermarkets could make direct selling a competitive enterprise worth diversifying into.

As oil prices rise, efforts will be made to utilise alternative energies.

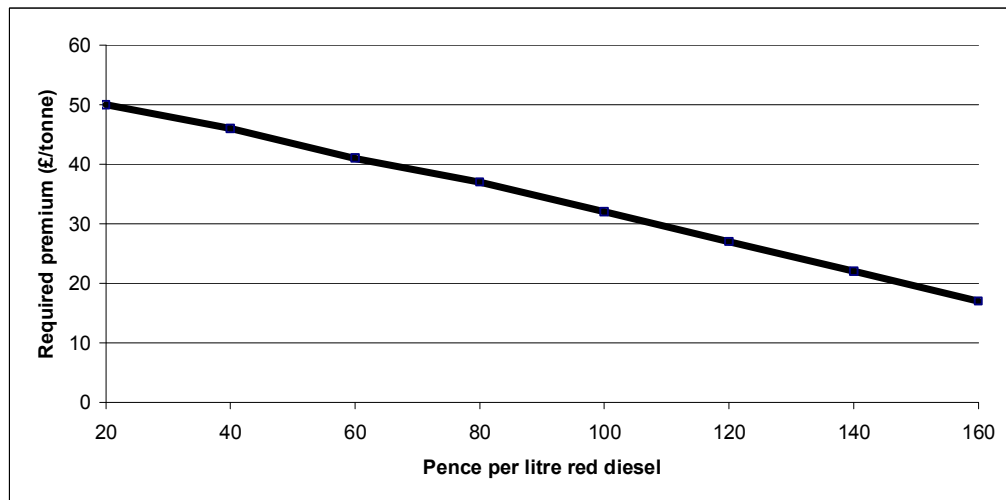
Higher fuel prices have already galvanised bio-diesel and ethanol production, although questions are being asked about the ethics of using a scarce edible resource to meet energy needs to any large extent. Additional land might be brought into production, but good quality land suitable for cropping is somewhat limited. It is unlikely that the UK would be able to produce more than the current 2010 target of five percent of petrol and diesel use unless food production is cut substantially or progress is made in utilising crop residues for bio-fuels. Any bio-fuel shortfall is likely to be met by imported palm oil or sugar ethanol from tropical developing nations. Outside of bio-fuels, a few farm businesses diversified into renewable energy production some time ago, with wind power being particularly profitable (Blaney and Bright 1995), and this may well increase.

Biomass as an on-farm energy source can also be a profitable venture, especially for those farms engaged in energy-intensive processes such as grain drying. Farm managers can install a biomass boiler to reduce (or cancel) their heating bill, or alternatively install a combined heat and power system that also generates electricity. Commercially available small-scale biomass boilers burn woodchips, straw, and waste material. The capital costs of a straw-burning heat-only boiler average around £10,000. Dry straw at cost (£15 per tonne) will provide heat at 0.6 pence per kilowatt-hour, whilst oil, gas and electricity are currently over five times this. Biomass boilers have pay-back periods of as little as a few years (Blaney, 1994). Growing biomass, such as miscanthus, under contract for local biomass power stations is also an option, but this will be limited to those farms who are fortunate to be located close to such a plant. It is also likely that there will be an incremental increase in demand for industrial crops since biomass as a source material for making chemicals becomes competitive at oil prices above \$54 per barrel (Milmo 2005). This may offer opportunities to a greater number of arable producers. Bio-gas production from slurry offers opportunities for livestock producers. Free advice on installing renewable energy technology is available from the Energy Saving Trust.

Finally, conversion to organic agriculture is an alternative that becomes more profitable as energy costs rise (so long as machinery use is minimised). In general, organic farming enterprises use much less energy compared to conventional agriculture (ADAS 2000). As a result of lower yields, a price premium is presently required for organic production to be as profitable as conventional agriculture (nearly £50/t for milling wheat at present). As input prices rise, though, the relative cost-effectiveness of organic production will improve. For example, by 2008 the increased costs in conventional winter wheat mean that the required organic price premium could be reduced by ten percent from £50 per tonne to £45 per tonne (based on the assumptions for conventional production in figure 2). If oil prices continue to climb beyond 2008, or temporarily soar, then organic wheat production would require an even lower premium (Figure 3). The same trend will also apply to livestock enterprises. Even with current input prices a switch from conventional fertiliser-reliant dairy systems to a more extensive grass and clover system could reduce costs by around £50 per cow (Gardner 2005). Alternatively, farmyard manure is a valuable source of nutrients, and by substituting it for

synthetic fertiliser a saving of over £1,500 per annum can be achieved by the average 100 cow dairy enterprise (FWAG 2005).

Figure 3. Declining organic wheat premium required as fuel prices increase.



Conclusions

Energy use is an issue of growing significance for agriculture not only as a result of rising fuel prices due to supply scarcity, but also because of the need to combat climate change. It is probable that agriculture will be expected to contribute toward the sixty percent reduction in carbon dioxide emissions required over the coming four decades. One way in which this might happen is through the extension of emissions trading to all businesses. Therefore, even without the near term problem of declining oil production, the price of energy is likely to rise in the medium-term. It is clear that the era of cheap energy is over. Farm managers would be wise to re-appraise their business investment decisions in light of this fact.

Higher energy prices in the future do not have to be an entirely negative experience though, as the coming situation will offer farm managers enhanced opportunities to diversify into biomass, bio-chemicals and bio-fuel production. Farm businesses that maximise profitability in the new energy era will be those that have reduced excess use of fuel oil, oil and gas derived inputs, and on/off farm transport. This could be accomplished by timely investment in fuel-efficient machinery (such as hybrid-electric tractors) and precision agriculture, or conversion to organic agriculture. There should also be improved prospects in direct selling or supplying local outlets.

As a result of rising energy prices there are likely to be technological and operational innovations and, as with most changes to business circumstances, it is those businesses which adapt first who make the largest gains (or smallest losses). Therefore, a strategy of keeping abreast of such innovations will be even more important than is currently the case. There are many drivers of

agricultural change on the horizon. However, entering the new energy era will join the few that have the potential to comprehensively alter the direction of farming.

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Disclaimer

The contents of this paper represent the author's view alone and in no way commit Scottish Natural Heritage.

Biographical notes

After gaining a PhD in agricultural economics at The University of Reading, Ralph Blaney worked for a year at the Department for Environment, Food and Rural Affairs on Farm Business. Following time spent working on his parents' farm in Cornwall he moved to his current position at Scottish Natural Heritage, where he has been an economic adviser providing advice on land use issues for four years.

CONFERENCE PAPER

CHINA: THREAT OR OPPORTUNITY¹

John Chapple

China's market of 1.3 billion people offers attractions to UK and European companies. This paper reviews my experiences of farming and working in China: it illustrates the potential of the country and its resource limitations. But despite these, its productive potential has already been felt in some crops (such as garlic and onions) as it has won markets from other exporting countries. These are only the first effects of China's re-integration with the global economy.

Introduction

Much is written about both the potential of selling into China's market of 1.3 billion people (20% of the world's population) and about the threat to our own markets from Chinese production. When these threats to agriculture are discussed, oversupply of products such as garlic, onions, and broccoli are cited as indications of the chaos to come. Some of this discussion is valid. Indeed, there will continue to be price pressure and change in market supply dynamics in the future, with products such as apples. But there are fundamental aspects to the character of China's agriculture that suggest that a much more complex and durable re-orientation of the world's agricultural market is taking place.

This paper explain more about China and the Chinese character, particularly from a food and agricultural point of view, and to examine and discuss the threats and opportunities likely to occur as a result of China's rapid re-integration into the global community.

What is China?

It's a big place teeming with people. The numbers are beyond comprehension, so let's firstly compare China with a country that we are much more familiar with, the USA. Both countries are geographically about the same size, 9.6 million square km. But that is where the similarity ends. 290 million people live in the USA but a massive 1,300 million live in China. There are 2 million farms in the USA but 220 million farms in China. And of course there is the significant and enduring difference in the two nations' history. In contrast to America, China can trace its history back thousands of years, and for most of that time China can claim to have been the most advanced civilization in the world. It is only in the last three hundred years or so that other countries have caught up and moved ahead.

Zhongguo - centre of the world.

It's important to understand that the Chinese consider that China's rightful place is at the centre of the world's community. Even the name conveys this, "China" in pinyin is Zhongguo, Zhong means middle and Guo means kingdom: the middle kingdom of the world. Our maps have the UK at the

1. This paper was first presented at the 60th Oxford Farming Conference in January 2006 "Towards a Sparkling Future". We are grateful to the Oxford Farming Conference for permission to publish this paper (further details of this and future Oxford Farming Conferences can be found at: www.ofc.org.uk).

center; China on the edge. Theirs have China in the middle UK falling off the edge!

So here in the central kingdom of the world resides 20% of the world's population, farming 7% of the worlds farming land, and producing a vast tonnage of food for its people. Maybe 500 million tonnes of fruit and vegetables a year (figures vary widely from 350 million to 800 million, a typical example of how difficult it is to find out the true situation in China - probably no-one knows).

So what is China now? It is a land of contrasts and contradictions, a nation that is changing collectively but with individual ambition; everyone wants to improve themselves or their children. There is an absolutely capitalist attitude to doing business. Anyone who tries to get involved in China who does not understand this faces deep trouble. Whatever China and its people are today will probably not be what they will become tomorrow, but whatever happens, the impact on the world is here to stay, and to further grow. China's development has only just started.

China's food – at the core of its culture

There is one thing I can confidently predict about China and its people and that is that food will continue to play an important part in their lives. Food is at the core of Chinese culture. "Chi fan le ma?" literally means "Have you eaten yet?" In my early days in China when asked "Chi fan le ma?" I would retort that no, but I would do later. However, I gradually realised that this is a form of greeting like "How are you doing". Wherever you conduct business in China, it is planned around meal times; generous hospitality with huge lunches and dinners. "Guanxi", personal relationships, take on an importance out of all proportion, and most of this is developed over the dinner table. If your knowledge of Chinese food is your local takeaway, you will not appreciate the wide variety of dishes available in various regions, but there are some basic common factors about all Chinese cuisine. It is fresh produce based.

Buy today what you eat today

Chinese prefer "warm meat" - beef, chicken, lamb and pork - consumed one day after slaughter. Cold meat is considered unfresh, a real problem for retailers trying to develop a robust food chain. Fresh fish is even more extreme; held alive in tanks in shops and restaurants and prepared immediately before cooking. Fresh vegetables and fruit are usually bought from daily "wet markets" and have little "shelf life". Recently dairy products have rapidly found favour. They are regarded as healthy and consumption of milk based products is rapidly increasing (consumption has increased from 5kg/ head /annum 10 years ago to 13kg /head, to put this in perspective, Americans consume 100kg/head).

China: a fast food culture and a nation of travellers

The Chinese love to eat out, not just for business but with family and

friends. On street barbeque vendors are common and in recent years western fast food outlets have developed quickly in China. KFC and MacDonald's are now common sights in many cities, along with Pizza Hut, which is gaining popularity. A number of Chinese owned chains of quick food restaurants are also developing selling western type food in addition to Chinese foods such as fast noodles.

As their incomes rise, the Chinese like to adopt certain aspects of Western lifestyle, and the opportunities for this are rapidly increasing. Hyper-markets such as Metro, Wal-Mart Carrefour are present, and Tesco will be there soon. Most of the International Hotel chains also have a presence as Chinese people become more interested in travel at home and abroad. They are exposed to more westernised films and TV, including Chinese versions of shows such as Pop Idol. However, they like to combine western concepts with Chinese tastes, rather than substituting one for the other. Access to these new influences is currently available to only that tiny minority with rapidly rising incomes, but this still represents a lot of people!

China: an agricultural nation

So China is a rapidly evolving market with quantum changes in lifestyle within one generation, but it must not be forgotten that agriculture continues to be a key influence. 750 million people rely on the rural economy for their livelihoods, comprising 49% of the labour force. Average farm size is small, about 0.1 ha/person, with land often fragmented, in parcels around the village, effectively run as market gardens, with most farmers relying on hand labour for many tasks, though there is some common ownership of rudimentary tractors, combines and other equipment. So growing enough food to feed everybody continues to be a challenge. There is less farmed land per capita in China than any other country except India (only 15% of land can be farmed).

Water (as well as land) resources represent a huge problem which is restricting development. Although multi-billion Euro projects are now underway to build water transport canals from the South to the North, most of this water will be designated for use by industry and urban populations. During the early stages of the establishment of the Communist regime, food production was a major challenge, particularly during the late 1950s the end of the 1960s when China became self-sufficiency in food.

China an importing nation.

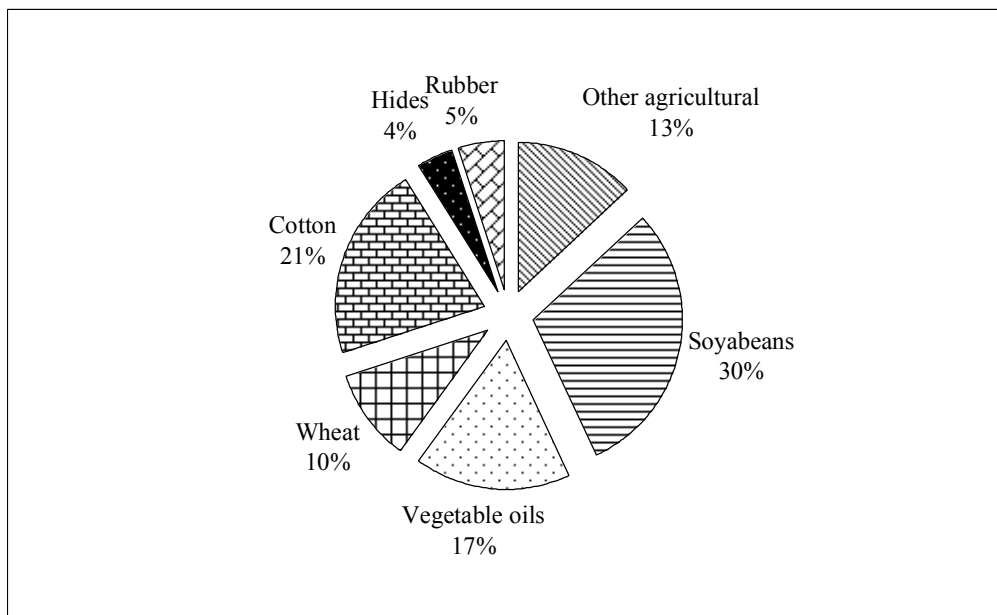
However, the challenge to remain self-sufficient is becoming more difficult and there is evidence that China will not be able to produce enough food of the type its people want in the coming years. Already, in financial terms, China is a net importer of food and feed (Figures 1 and 2): China cannot produce enough food to feed its burgeoning demand. The level of food and feed imports must surely rise as diet changes and more people leave the countryside, with at least 200 million expected to migrate in the next 20 years. This trend will continue to increase demand for commodities.

So the numbers of consumers who will need to begin new lives in cities and large towns is considerable. As discussed above, some 200 million people must migrate from the countryside in the following 20 years if rural incomes

Figure 1. China's agricultural trade (2002-04).



Figure 2. Composition of value increase of China's agricultural imports



are to be sustained, and the industrial economy continue to develop: the equivalent of the entire population of Germany, France and Britain combined suddenly wanting to go to the market to buy their food and experience new tastes and experiences.

China- farming's problems

So why is Chinese farming not able to respond by producing the quantity and type of food demanded? Farming in China has particular problems. As well as farming myself in Shandong province, where more produce is grown than any other region of the world, I have travelled to many parts of China and experienced the following common phenomena.

Heavy pest pressure

This is due to the intensive way that the land is farmed with two or three crops a year, depending on the region, and the use of polythene covered “warmhouses” for winter production, that are effective winter resorts for pests and diseases.

Fragmentation of farm units

While there are some massive livestock units and huge (15,000ha) ex-state farms on the Russian border, the average farm size is around 2 mu per person (15 mu equals 1 ha). Attempts to consolidate the farming areas are often frustrated as farmers guard their right to their land jealously, and the allocation is arranged at village level by the village leaders. The average farm unit allocated to a family member varies, but in Shandong it is around 2 mu. This may not all be in one block, but spread around the village and it is difficult to persuade farmers to amalgamate their land.

Water problems

China's climate would seem extremely challenging to those of us from the UK used to a relatively benign climate. As well as having to cope with extreme temperatures in most regions, farmers in the South are continually battling with too much rain during a large proportion of the summer, while farmers in the North rely on a relatively short rainy season in June and July to sustain crops for the whole year. In addition, desertification is a threat in the West and North. China is currently developing two of three planned water-transport canals with a budget of some 40 billion Euros-to transport water from the South to the parched North, though most will be allocated to industrial and city use.

Soil problems: low organic matter

On taking control of our farm in Shandong we discovered two features that I believe are common to many soils in China; extremely low organic matter, and a soil pan a few centimetres below the surface. Both features are indicative of soil that has been worked very hard and offered little opportunity to recover. While only one crop a year is grown in the frozen North, two crops a year are grown in mid-China, and three crops a year in South China.

Soil problems: Salinisation after intensive irrigation

Crops in North China have to be irrigated continuously if grown between March and June. The cold winters desiccate the soil, and there is no significant rain to replace the depleted moisture till June and this intensive irrigation leads to salinisation and acidification of the predominantly silt soils in the prime growing areas.

Purchase of inputs

It is difficult for farmers to buy good quality inputs, partly for financial reasons and partly because of the fragmented supply chain.

Ineffective post harvest infrastructure

Post harvest storage of produce tends to be ineffective. The cool chain remains a major problem for producers trying to deliver product with a reasonable shelf life.

Incomplete support structure

In Britain we are accustomed to a comprehensive support structure from government departments and agencies and from the many commercial support organisations and individual consultants. We take this for granted. China has a government agriculture support service but it is a huge task communicating with 200 million farms and there is very little commercial support for the industry. The need for this is not yet understood, and generally there is little margin in the food chain to pay for such support. Sino Analytica is one of very few such independent organisations supporting food businesses in China. This lack of pro-active support services is restricting the development of a robust food chain from farm to table.

China: threat or opportunity, or both?

So what does this mean for the world's agriculture? Is China a threat, opportunity or a combination of both? Well it's certainly a threat to certain particular segments of the industry. With its annual production of fruit and vegetables, being somewhere around 400-800 million tonnes (570million was a figure suggested last year), if China produces any sort of surplus this can rapidly lead to glut. This has been witnessed with garlic exports to the USA, broccoli to Japan, and will almost certainly be witnessed in the near future in the apple and pear sectors. But China is not the "best place to grow" many products. Its climate, water problems, and pressure on soils, really does limit its potential. Many people do not understand this, pointing out that as the prices for food are so low, it is a cheap place to grow. But farmers do not adequately calculate the real costs of production, and many families subsist on an annual income of £200/year.

My prediction is that although in certain markets China will be influential exporters, overall I think the emerging challenge to feed its people will

overshadow the food industry for the foreseeable future. We have already seen the impact on other commodities such as oil, steel and copper. Now we are going to see the dramatic impact on commodities such as soya, vegetable oils, wheat, barley and maize. Feeding the world is going to become an increasing challenge, especially with India, another country short of land, also experiencing rapid growth and development, and presumably a greater demand for food.

Opportunities for the UK industry?

Frozen exports to China have very limited potential, and UK companies supplying niche markets in Japan, Hong Kong, and East Asia, will ultimately see these markets supplied by Chinese companies. There will possibly be some opportunities for the sale of good quality barley for the rapidly expanding beer industry, but the market is extremely price sensitive (a pint of my local beer, Tsingtao beer in the shops costs 20 pence). Wheat sales will have to compete with Canada and USA.

There are limited opportunities for western organisation to farm in China. I cannot think of one western company that has come to China to farm which has succeeded in being profitable. There is an opportunity to sell agricultural technology to China, and I could write a whole paper on that! The problem is getting a sustained return for the investment in time and technology. However, I believe dairy production is an interesting area given the rapid increase in demand noted earlier. But multi-nationals such as Nestle are managing their own dairy herds and dairies here already, and facing very stiff competition from local organisations such as “Bright” milk.

In developing any agriculture business in China, businesses in the UK and Europe face stiff competition from the “Asia Rim” countries such as Canada, USA, Brazil and other South American countries, and Australia. My personal view is that these countries have much stronger agricultural support presence in China with a number of “seed corn” projects supported by their governments, with inward investment supporting educational establishments and lobbying access to the government in Beijing.

Finally what should UK growers be wary of in the near future? Fruit such as apples and pears must be an immediate concern. Frankly in my experience a Chinese Fuji apple competes well on the market in taste and keeping ability - better than most fruit available here, and vast quantities can be produced. Other competition depends on the development of cool chain air-freight from China. If this is developed in the near future then fresh vegetables similar to the produce from Africa will be easily shipped from China, and with the time difference just in time deliveries are possible. Fresh flowers from Yunnan province will most certainly be a factor in the European flower industry soon.

Another problem for the UK grower will be the loss their markets by Chinese exports. Onions are an example of this. Previous USA exports to Japan have been largely replaced by Chinese exports, and USA onion growers now need to find new markets.

Summary

China's impact on the world economy will not be temporary. It will become a dominant feature. It is not surprising that this is happening now; it is amazing that 20% of the world's population opted-out of the world's economy for so long. China is impoverished for resources - land, energy and water. So, despite China's farmers being good farmers, new techniques and seed varieties are not going to dramatically transform yields: there are too many other dominant limiting factors - not least a very difficult climate.

Chinese farmers will continue to produce the labour intensive crops need to generate the cash needed to buy better technology and seeds. Even though 200 million will leave the countryside in the next 20 years, 500 million will remain, and the continuing challenge will be to increase farm incomes above subsistence level. I do not believe they can significantly increase their incomes by growing commodity crops.

Chinese diets will continue to evolve, increasing the demand for commodities and animal feed with which to produce western style products. More commodities, but not vegetables and fruit, will be imported from the world market. More fruit and vegetables will be exported.

Conclusions

The world is going to see the demand for foodstuff commodities rise exponentially in the coming years driven by demand from China, and probably India. I believe that most people do not fully understand the implications of this; to most of us China is a distant place that produces just cheap DVDs and t-shirts. Through this paper I have tried to portray a more agriculturally oriented country, and outline some of the impacts that this predominantly rural economy is likely to have on all of us as it maintains its rapid transformation, to a modern industrial economy, a transformation that it has barely started! I hope that after considering this paper, you will have some insight into this transformation and consider that China **WILL** have an impact on your farming and food businesses, but perhaps not in the way you had anticipated.

Biographical Notes

After Newcastle University John spent 19 years at CWS Agriculture (later Farmcare). Latterly, as well as practical farming, including agronomy of a wide range of crops, he was responsible for developing new vegetable, potato, and other commercial initiatives for the group, as well as acting as an agricultural issues strategist for the Co-operative Retail group. He was one of the founding members of the Assured Produce Group. In 1999 he moved to China, and established a farming and processing operation exporting to demanding clients in Europe, USA and Japan. Recognizing a demand for an independent residue analysis laboratory he founded Sino Analytica in 2003, China's first world class independent residue analysis laboratory. He continues to manage this business as well as advising a range of clients on farming and processing issues in China.

CONFERENCE PAPER

**WIDENING HORIZONS FOR DAIRY FARMERS:
LINCOLNSHIRE POACHER CHEESE¹**

Simon Jones and Tim Jones

By deciding to sell milk as cheese rather than liquid in 1992, the farm can now provide a living for two brothers and 12 employees. Cheese making started in a small way to establish key production skills. Marketing expertise was developed through involvement with a local cheese wholesaler. The result is that the farm business now sells one and a half million litres of milk as cheese each year. This paper reviews the key stages in the development of this cheese making enterprise.

Key words: cheese making, dairy enterprise, business, growth, diversification.

Introduction to the farm business

We have a dairy farm in Lincolnshire on which we make our Lincolnshire Poacher cheese. Simon runs the dairy herd and the farm and Tim manages marketing, distribution and sales. We farm 800 acres of mixed organic land nestling in the Lincolnshire Wolds. The farm has been in the family since our great grandfather started farming it in 1917. We have a simple rotation of 3-4 year clover leys followed by winter wheat, spring beans and triticale. Our 230, mainly Holstein cows, produce 2 million litres of milk per year, three-quarters of which we are currently turning into cheese. The cows have just started their organic conversion.

Simon joined the farm business in 1988 and, needing to find my own niche in a well run, modern farming enterprise, researched cheese making. In February 1992 the first batch of Lincolnshire Poacher was made in an old converted 1,000 litre bulk tank. Simon did this weekly for the next eight months, at which point we decided to train and employ a full-time cheese maker to raise production to four vats per week. In 1995, we moved into our present cheese dairy where we currently convert 30,000 litres of milk into three tonnes of Lincolnshire Poacher Cheese each week. It is a raw milk, hard pressed cheese that we mature for 15-24 months and the truckles weigh roughly 20kg each.

At the very start we were approached by a small local cheese wholesaler who asked to distribute our cheese. We agreed, and this arrangement continued for eight years, at the end of which the farm owned half the business and both Tim and myself were directors. As the non-farmer in the family, Tim worked as a market analyst for a soft drinks company after graduating in 1992. Although happy, the opportunity to come and work in the wholesale business selling all our cheese, was too good to miss. After joining the business in January 1998, Tim spent two and a half years working there before, in September 2000, leaving the wholesaler to work at the farm and so allow me to focus purely on selling our own Lincolnshire Poacher cheese.

Sales growth

It is now five years since Tim made this change and sales have risen healthily, volume sales have increased by 140% and value by 240%. This

growth is largely down to the fact that the farm has total control of the whole process from managing the cows to selling the cheese. Wholesale customers in particular like buying direct from the farm, as we are able to respond to their needs easily; we can get the right cheese to the right customer and at the same time answer all their questions.

Sales channels

The farm has five main channels through which it sells the cheese; something the farm is very conscious of is that the business does not become overly dependent on any single customer. At the moment, our largest single customer accounts for about 15% by volume so if we were dropped by anyone, although it would obviously have an impact, it would not be too dramatic. We have seen cheese businesses that have put a large proportion of their product through one customer and then suffered the consequences of losing control to the customer.

Wholesalers, export and delis direct

Our wholesalers (of which there are about 15) give us good national coverage in the independent trade. Some shops, however, prefer to deal direct so we supply about 100 separately. This includes places like Harvey Nichols and Fortnum and Mason as well as lots of farm-shops and delicatessens up and down the country. One wholesaler now exports the cheese, mostly to the US. This is an area of great opportunity and last year we enjoyed a couple of business trips overseas to promote the cheese. The first was to the largest cheese festival in the world, held in Northern Italy. Hundreds of cheese producers from all over the world were represented there, and we were one of about 20 British producers.

The second trip was a whistle stop visit to the US, taking in Chicago, Detroit, Philadelphia and New York in a week. The aim was to visit retailers and wholesalers who take our cheese. They were really excited to meet us, the producer of this cheese they love. It is hoped that the US market will be a growth area for our business.

Multiples

The farm sells to just two multiple retailers, Waitrose (which sells our cheese in all of its 170 stores) and Sainsbury (which stocks the cheese in about 140 of its stores). This means the cheese is available fairly widely across the country and it must be said that their exacting standards keep us on our toes!

Farmers markets

The final channel is farmers markets. The farm currently does between 40 and 50 farmers' markets per month. Farmers markets have been fantastic for the business in a number of different ways. They give opportunities to engage and educate the public about the product and the farm. For example, allowing tastings of the cheese at different ages and comparing a summer with a winter

cheese. This contact means that when they are next at a cheese counter where ours is one of the 50 cheeses on display, they are more likely to buy our cheese. Without doubt our trade sales have grown on the back of farmers markets. It also keeps us very much in touch with our market place, as the regularly public sampling provides direct and instant feedback – if there was something which they are not happy about we'd find out about it immediately.

Factors important to our success – past, present and future

Small beginnings

As outlined above, production began in a small way and we have kept a fairly tight control over supply. In this way we ensure that we are not left with surplus cheese that we then have to go out and sell – we'd much rather it sells itself. This also means that we haven't had to put too much pressure on production, which helps us to maintain the highest quality all the time.

Price makers

The numerous steps we have taken since cheese production began have meant that the farm is very much in control of its own destiny. We are able to set our sales agenda without being dictated to about price. This emphasis is on keeping margin high. This means that there will come a point at which we stop producing any more, because if volume keeps on growing, at some point, price and therefore margin will come under pressure. The important thing will be for us to know exactly when that point has been reached.

Contrasting characters

As outlined above, as key players, we are different characters with different skills and different personalities. It turns out that this ties in perfectly to the business. It leaves Simon free to manage the herd and the farm, and Tim to worry about sales, distribution and marketing. Nevertheless, we discuss all aspects of the farm and cheese making together. But ultimately there are clear boundaries as to who makes which decision and we're both pretty good at respecting this.

From cow to customer

Our ability to educate and pass on our enthusiasm to our customers is a huge benefit to us and is something that we will always continue to do. It's no longer just any old cheese, it has come from specific cows on a specific farm and is hand made by a specific cheesemaker - it has genuine provenance. And this is something that is becoming increasingly important to the consumer.

Product quality

Undoubtedly the single most important factor in determining our level of

success both in the past and in the future is the quality of the product. It's very hard to make repeat sales at high margin with a product that isn't fantastic. Ultimately we will live and die by the quality of our cheese.

Pitfalls and setbacks

Summer cheese

At the start we had problems with the cheese when the cows first went outside as this coincided with a change in feed from a mixed ration to a purely grass diet. The cheeses took on a farmyardy, almost sulphurous flavour and were definitely not good enough to sell: we ended up throwing away quite a lot. So we started to buffer feed the cows to balance out the milk and, in addition, have learned how to handle the cheeses in the vat much better at this particular time of year to stop them heading in the wrong direction.

Staff

About three years ago the farm needed to recruit an assistant cheese maker and this proved to be surprisingly difficult. Several adverts were placed in the local press, as we weren't looking for someone with experience, we didn't think it would be a problem. The first chap lasted a month, the next chap managed just a week. Finally, a year later, we took on Edward and he has been with us for the last two years. We have got some excellent staff and in particular our key members of staff. And it is vital for us that we hang on to them because finding really good staff is always going to be hard for us.

Stock management

One of the most difficult jobs is production planning. As mentioned above, we keep the cheeses for up to two years, and so need to predict sales two years in advance, and this is never easy. Three years ago we went through a period of rapid growth that we had not anticipated, it meant that we had to stop selling cheese for a month and we ran out of the Vintage Lincolnshire Poacher cheese, which is at least 18 months old, for a six month period. This was hard to handle because people were used to having everything available all of the time. We have learnt, our predictions are now much more bullish – we don't want to go through that again.

Cashflow

One obvious result of producing a well aged cheese within a growing business is a rise in the level of stock. This increase in stock puts a constant pressure on cashflow as the number of milk cheques we receive diminishes.

TB

Although we are in a non-TB area, the threat to us as raw milk cheese

producers is huge. If the farm was to get TB then the cheese stock could potentially be destroyed. As a result, we take every measure to protect ourselves from getting TB.

Opportunities for dairy farmers

Not every dairy farmer can or will go into cheese production. Indeed, taking this step would not be the right move for everyone. However, we are absolutely sure that there are opportunities for forward thinking, ambitious, passionate dairy farmers to produce and sell cheese successfully, and we would like to see more people going out and having a go. There are increasing numbers of consumers out there looking for interesting, excellent tasting farm made cheeses and this is a trend that is likely to continue.

When the first vat of 1,000 litres of milk was converted into cheese, who could have imagined that within 14 years the farm would be converting one and a half million litres of milk each year? Without the cheese enterprise, the farm could not employ both of us. We now employ 12 staff. The initial decision was clearly a huge step, and it is often impossible to imagine where large steps might lead. But for those who take that step with passion and commitment, and are prepared for lots of hard work, the possibilities are endless.

Biographical Notes

Tim Jones completed an Economics degree at Exeter University in 1992. He then worked for several years in a large market research agency, mostly within FMCG. He switched to the client side when he became Market Analyst for a large soft drinks company, which involved the organisation and analysis of research data for both the Marketing Department and the Main Board. In 1998, he joined the family farm to help with the sales, marketing and distribution of the cheese and has been with the business ever since.

Simon Jones graduated from Cirencester with a National Diploma in Agriculture in 1986, then spent two years working and travelling abroad to Africa, India and Australia. Following this, he returned to the family farm in 1988 and took over the management of the then three dairy herds and started to research cheese making. In February 1992 he started making Lincolnshire Poacher Cheese and in 1998 became Managing Director of the business with the retirement of his father.

VIEWPOINT

IS THE GOVERNMENT USING THE BRITISH FARMER AS A SACRIFICIAL LAMB?¹

Tim Bennett²

The future state of UK farming is being decided away from the farmyards and fields. Negotiations in Hong Kong on world trade issues, in Brussels and London on the Fischler reforms and the introduction of the single farm payment, and among competition commissioners, is shaping our future. But many of the arguments driving these changes appear to be poorly understood. It is argued here that unilateral decisions undermine UK farming's competitiveness which threatens the future of the sector, and the provision of public goods and the maintenance of rural communities that is the very fabric of the British countryside.

Keywords: agricultural reform, World Trade Organisation, competition, CAP, single farm payment.

Introduction

We come to this Oxford Farming Conference in the midst of challenging times for the agricultural sector. In recent weeks, agriculture has been in the news, not always for the right reasons....and predominantly presented in an inaccurate and uninformed way. A prime example of this is the public debate surrounding the Hong Kong WTO Ministerial. Both media and NGOs have consistently presented European agriculture as a convenient 'scapegoat' that is at the origins of all the wrongs in the world, from the failure of the Doha round to world poverty. The distorted picture is not just the work of the NGOs and the media but, sadly, the British government. The recent agreement on the EU budget was preceded by demands by the British government (more on this below) for further reform of the CAP, as though the radical reform agreed in 2003 had not taken place. The recent Treasury document on a 'Vision for the Agricultural Sector' underlines the extent to which government policy is informed not by reality but by rhetoric.

We are a sector competing in global markets but we are affected by realities defined at the global, European and national level. World trade matters, but so does the CAP and the burden of regulation imposed by the national government. So do the commercial realities of the supply chain. We can't just look at one part of the picture; we can't refer to the impact of trade liberalisation on our businesses without considering the constraints that we encounter and the uneven playing field that we face.

The challenges are numerous, but we need to focus on how we can improve things. In order to succeed, we need to gain not only consumer support but also public support. In these times of global competition, more than ever, people need to understand the value of British agriculture, why British agriculture matters not only as a provider of marketable goods (both

1. This paper was first presented at the 60th Oxford Farming Conference in January 2006 "Towards a Sparkling Future". We are grateful to the Oxford Farming Conference for permission to publish this paper (further details of this and future Oxford Farming Conferences can be found at: www.ofc.org.uk).

2. At the time of making this presentation, Tim Bennett was the President of the National Farmers Union.

food and non-food products) but also because of its role shaping the countryside. We need to explain the reality of the sector, and not allow free rein to the myths promoted by the misinformed, misguided or malevolent.

World trade talks

Let us start with the world trade talks. They are of massive importance to British agriculture. A deal will affect our competitive position both in domestic and international markets but it will also change the patterns of competition in international markets.

When I was in Hong Kong, most of the time was spent on export subsidies, which, let us not forget, the EU had already agreed to give up in 2004, provided others do the same. The UK is not a major user of export subsidies on primary agricultural products, because most of our export trade is within Europe rather than outside. But the loss of these subsidies will have a number of important indirect effects. It will, for example, restrict Irish beef exports to the rest of the world. It will mean European sugar production will have to be cut even further and it will make it difficult, perhaps impossible, to operate intervention for cereals and will impact on manufactured products from chocolate to whisky.

In fact, most European export subsidies are not used in poor countries, but we must recognise that in some cases they have caused damage and are, for that reason, indefensible.

We can learn to live with their elimination, but only if all equivalent measures in other countries (most notably generous credit terms, export trading enterprises and food aid programmes) are disciplined at the same time and in the same manner. The European Commission stood firm on this principle in Hong Kong, despite the mounting pressure from some development NGOs and media (mainly British) that Europe should give way. The final agreement in Hong Kong recognises the need for this 'parallel' treatment. A major success, both for developing countries and for European farming, for which I salute the efforts of Commissioners Mandelson and Fisher Boel.

But we must stay on our guard against the double standards of countries, like the US, that criticise the EU for using export subsidies but continue to use food aid programmes designed not to aid the poor of the world but to support their own farmers, agribusiness and logistics companies. Not to speak of their use of unfair credit terms, or domestic support that (unlike our own decoupled payments) are very trade distorting.

The European Commission came under intense bombardment from many sides before Hong Kong: from European farmers, and some governments, who thought it had gone much too far, and from most British commentators and some governments who thought it had not gone far enough. I think the Commission did a very good job. There is no doubt that the 2003 CAP Reform puts us in a much better negotiating position. And the recent sugar reform contrasted starkly with American intransigence on their cotton subsidies. As a result, it was the Americans who came under big pressure from the Africans, and were forced to concede much more than they had wanted.

That said, the Hong Kong talks entirely ducked the issue of import tariffs.

There was an agreement, which looks very unrealistic, that this issue should be concluded by the end of April. So, whether this deadline is met or not, we are in for another four months of accusation and recrimination, and, regrettably, misinformation.

The negotiations on market access are undoubtedly the trickiest part of the negotiations for British agriculture. Because we are not large exporters of primary produce outside the EU, we have not much to gain from greater access to other countries' markets. On the other hand, increased access to our market is bound to put further pressure on our prices, and in some cases lead to higher imports. This will affect the whole of British agriculture, and sectors such as beef, dairy and poultry could be dramatically affected as a result.

I do understand and accept the principles behind trade liberalisation, but I am exasperated by the way some of the facts and arguments are often presented. Top of my list are those who present the CAP as an immoral attack on poor countries and Africa in particular. Opening our markets, the argument runs, would be the single greatest contribution to making poverty history. There are several conspicuous flaws in this argument.

First, it is normally put forward in ignorance of the fact that Europe already has, since 2001, opened up all its markets by allowing, through the Everything But Arms initiative, duty-free and quota-free market access to the poorest countries, including most of Africa. This is an initiative that other industrialised countries have only just promised -in Hong Kong- to match but have not yet achieved. In terms of the actual trade flows, the EU imports more farm products from developing countries than the US, Japan, Australia, New Zealand and Canada put together and absorbs 70% of the imports from Least Developed Countries while the US only takes 17%.

Second, in the absence of other measures, free trade will only make the poorest countries in the world poorer. The World Bank recognises that the main beneficiaries from liberalisation will be developed countries such as the US, Australia and New Zealand, and (increasingly) Brazil and Argentina. The overwhelming losers will be in sub-Saharan Africa. The reform of EU sugar regime illustrates this: the reform of the sugar regime will, by making their preferential arrangement less attractive, reduce sugar revenues in the Everything But Arms countries (that is, the poorest countries in the world) by 40%.

Third, there is something frankly patronising about the proposition that free trade in agriculture will help the poorest countries; patronising both to developing countries and to those of us in farming. The underlying belief seems to be that agriculture is a fairly primitive activity, suitable only for countries in the early stages of economic development, where cheap labour will make you competitive, then to be abandoned for something more rewarding. Well, I don't need to tell this audience how mistaken that is. Farming is now a very sophisticated activity, requiring great technical skill, a large amount of capital investment, and, in most cases, very little labour. Agronomically, the advantage will always be with temperate regions.

None of the above is an argument against trade liberalisation. But it should warn us against the simplistic arguments often advanced, sometimes even by our own Treasury. Trade will provide an opportunity for developing countries,

but they will only be able to take it if they have stable and uncorrupt governments, land reform, a fair tax system and functioning markets. And a good start would be to have regional single markets, as we have done in Europe.

Rumblings alongside the world trade talks have been the concerns about the impact of freer trade on environmental and other standards. This would be a subject for a fairly long lecture in itself; and I will limit myself to a couple of remarks. Realism dictates that in the foreseeable future trade restrictions will only be allowed where there are genuinely global concerns: trade in endangered species for example. This leaves us with a situation in which products produced under lower standards will have access to our markets. I do understand that the purpose of freer trade is more consumer choice; but choice brings with it responsibility and this is not always adequately exercised. Information is key – the public needs to know what are the effects of different production methods. Nothing in the WTO limits our ability to use private assurance schemes and labels; it is our job to explain to the public the qualities and standards that underlie the Red Tractor and to convince consumers to prefer our products. It should not be an impossible task and one where other parts of the supply chain should also take responsibility to ensure responsible and dependable buying.

Domestic support

WTO negotiations have also brought to the forefront the issue of domestic support. Most of the public discussion utterly fails, yet again, to address the real issue: domestic support for agriculture is justified, and allowed under the WTO framework, as far as it is not trade distorting. This is recognised by WTO itself in its differentiation between trade distorting (Amber Box), less trade distorting (Blue Box) and non-trade and minimally trade distorting (Green Box) agricultural support. The common objective in WTO is to reduce farm subsidies that distort international trade, not to reduce overall support for the agricultural sector – the rest is rhetoric.

The radical changes undertaken in the context of CAP reform have already succeeded in shifting most of our domestic support into the Green Box by breaking the link between support and production. Our position is clear – countries should be able to support their agricultural sector in the pursuit of their chosen agricultural and rural model as long as this is done within the context of the Green Box. But, the use of trade-distorting schemes should be further restricted. Therefore, we have an interest in curbing support programmes in some competitor countries, most notably the USA. Their ‘countercyclical payments’ on cereals and oilseeds are particularly trade distorting because they protect farmers from low world prices and encourage farmers to plant, even when market signals are telling them not to.

Although we have reformed the CAP, if you listen to politicians you wouldn’t think so. If I were being generous, some of this confusion might arise because “reform” is a politician’s lazy way of saying budget cuts. But I am not inclined to be generous. CAP reform has come to be represented as a kind of “Magic Wand” that might provide the resolution not only to the WTO trade talks, and world poverty but also to any crisis of the European integration

process. Moreover, some media voices have been keen to present the farming community as a selfish group wishing to preserve the CAP at any cost. These are the same voices that overemphasise the percentage of the EU budget devoted to the CAP while, conveniently (for them), neglecting the fact that the CAP represents 40% of the EU budget only because the EU has not responsibilities for health, education, or any of the main expenditure items associated with government activity. In fact, the CAP expenditure in the UK amounts to some 0.5% of total government expenditure.

The simplistic representation of the CAP reform issue fails to acknowledge a number of issues. Firstly, it is appalling that the same government that welcomed the radical reform in 2003 as promoting the role of farming as a business is not willing to recognise that businesses need a stable environment to allow them to plan. This is especially ironic when Margaret Beckett welcomed the agreement at the time by saying (and I quote): “This agreement delivers what we want: real change”. Can a business that has just started adapting to the last reform start thinking about further reforms? And how is a business expected to cope with an unannounced, unjustified shortfall in cash flow? This, and more, is what farmers in this country are being asked to do as a result of, respectively, the calls by British politicians for further reform of the CAP and of the failure of the Rural Payment Agency (RPA) to deliver the Single Payment Scheme.

In fact, the position of the British government has become so extreme that Peter Mandelson (yes, that same Peter Mandelson!) has become a ‘voice in the desert’ of British politics and stressed the need for agricultural support for wider and strategic reasons. In his own words: “We want to sustain agricultural production in Europe, we want some degree of agricultural self-sufficiency, we want some security of our food supply. [...] Reform needs to continue, but it needs to go at a pace that is manageable and absorbable by the European farming community. Overnight revolutions are not possible and (...) demands for dismantling [the CAP] are misplaced”.

A common reform to the CAP

This is, I believe, a critical message: farmers do not reject change. Indeed, we accept it and recognise the need for market focus, but timing (as with everything) is crucial. It is also crucial that any reform of the CAP is indeed a ‘common’ reform. I object strongly to British farmers being the ‘guinea pigs’ on which CAP reforms are tested – the 2003 agreement on CAP reform opened the way for re-nationalisation of the CAP by allowing for different degrees of decoupling and differences in reform implementation.

And the recent deal on the EU budget-announced during the Hong Kong talks-presents even more causes for concern. Concerns that are shared by the President of the European Commission who, in a letter to Tony Blair, has highlighted the competitive distortions that might arise from the introduction of voluntary national modulation with no match-funding. Our rejection of this concept is, and will continue to be, unambiguous. The adoption of voluntary national modulation will risk putting us at a disadvantage with respect to other EU countries.

According to the budget deal, match funding will no longer be obligatory

from 2007. If our government do in fact refuse to match-fund it will be a government betrayal of previous assurances of their financial commitment to rural development and will represent an active policy decision that will disadvantage British farming.

One might have hoped that others in Parliament would be trumpeting the risks the government has led us into. Sadly, not. What can we expect from an opposition where the Tory leadership does not recognise the reforms already undertaken or the importance of the sector? Their CAP headline grabbing comments are equally appalling.

We are increasingly running the risk of one of the most forward looking, most environmentally aware, most quality-led and market focused agricultural sectors in Europe being put at a disadvantage by its own politicians. I have a wonderful example. The recent clamour by British politicians for CAP Reform has brought a predictable result: other countries have said capping of payments must be the first item on any new reform agenda. I am sure we will fight this off yet again; but yet again we will have to waste time and energy to do so. If only our politicians' skill in own goals was matched in the other penalty area!

Market orientation and competition policy

I have already said that British farming has not set its face against change. We know we have to face more international competition, and we strongly suspect that there will be budget cuts at some point in the future. To cope with these, we need to seek even more of our returns from the market. But to do this we need a food chain that is working efficiently and fairly. Currently, large parts are neither fair nor efficient. As a result of the 'old' CAP, not only have processors taken full advantage of CAP payments (let us remember that a sugar processor is the largest support recipient in the country) but processors and retailers have benefited from a ready supply, resulting in a supply chain driven mainly by prices: a supply chain where all the costs and adjustments have to be made at the producer end. This is not sustainable. Recent profit announcements demonstrate clearly that there is enough profit in selling food in this country to ensure that farming suppliers also remain viable businesses.

Constructing a functional supply chain will require much more partnership than we have seen in the past. There are some signs that this is at last getting off the ground. But it cannot entirely be left to take place on its own. We will also need a serious change of direction from the competition authorities. We cannot continue with a situation where consolidation at retailer level is permitted but even the most marginal increases in scale in the rest of the chain are effectively blocked, even when they would, as in the case of the proposed Wiseman's takeover of Scottish Milk Dairies, contribute towards the achievement of the economies of scale required to compete effectively at the international level.

As President of the NFU I have seen farming from two very different perspectives. First as a young first-generation farmer, struggling to develop my own business, and secondly as a witness at global meetings, where governments from around the world argue about the future of agriculture with a mixture of self-interest and ideology. Faced with the big outside pressures of more liberal world trade, and a government retreat from involvement in

markets, it is understandable that many farmers feel frustrated and pessimistic. I am convinced there is a prosperous future. But all of this can only be achieved if the same governments that tell us to be market focused, allow those markets to function properly.

Conclusion

What is at stake is the future of a sector, the provision of public goods, the maintenance of rural communities and the very fabric of the British countryside. The future of a sector that is important in the global economy, but also crucial for the nation, for the countryside, for the villages and the people of this country. Let us not forget that the agri-food sector provides 3.8 million jobs in the country; that population growth, climate change, bio-security and other concerns are likely to make agricultural commodities and food production more crucial than ever. Let us not forget that farmers manage 77% of the land in the country; that the loss of working farms is the main public concern about the countryside. Surely we do not want to be so short-sighted as a nation as to forget all that? Or is the government using the British farmer as a sacrificial lamb?

Biographical Notes

Tim Bennett was elected President of the NFU in 2004, having served as Deputy President for six years. He has served on the NFU's Livestock Committee, and its Finance and Organisation Committee. Mr Bennett worked in France after agricultural college and moved to South Wales in 1978 to begin farming. He now owns a 220 acre grassland farm in Carmarthen, West Wales, where he is presently rearing dairy heifers for sale and developing a suckler beef unit based on the Aberdeen Angus breed. He has always taken a great interest in producing for local and regional markets. Tim Bennett is also currently a Member of the Agricultural Land Tribunal and Governor of the Institute of Grassland and Environmental Research. A Fellow of the Institute of Grocery Distribution and an Associate of the Royal Agricultural Society, Tim was appointed as a member of the Council of Food from Britain in July 2005.

REFEREED PAPER

FARM RISK MANAGEMENT: PAST, PRESENT AND PROSPECTS*

J Brian Hardaker

The integration of ideas about utility and subjective probability into modern decision analysis is outlined. Despite being widely adopted, some aspects are still contentious. The legitimacy and practicality of utility functions to reflect risk aversion has been challenged and there is far from general acceptance of subjective probabilities as a basis for risky choice. While subjective expected utility does not always explain behaviour under risk, it is arguably the best basis for prescriptive decision analysis. The focus on the limitations of utility theory may have diverted attention from the more important task of devising and applying ways to get good probabilities, especially in data-sparse cases. It is argued that more attention needs to be given to the important risks that farmers face. As these are often those for which frequency data are sparse or unavailable, the need for wider acceptance of well-considered subjective probabilities as descriptors of uncertainty is clear, requiring a difficult paradigm shift.

Key words: Risk, farm management, decision analysis, subjective probability, risk aversion.

Introduction

My aim in this paper is first to outline, unavoidably very superficially, the history of thought about risk and its management. Then I shall try to summarise where I think matters stand at present with regard to risk management. Finally, I shall offer a few comments about what the future might, or should, hold. While much of the paper applies to risk management generally, I have tried to set the discussion in the specific context of agriculture, especially farm-level risk management.

The past

Until relatively recent times, risk got little or no attention, at least in farm management research and advisory work. Reasons for this include:

- A culture of pretended certainty, which still exists to some extent today – who would take notice of an adviser (or political leader) who admitted, however truthfully, that he or she really had very little idea about what the future might bring?
- No widely accepted theoretical foundation that allowed any form of risk analysis to be rationalised; consequently, no well-developed and widely-accepted methods of analysis.
- In any event, with no or few computers and little specialist software, it was all too hard.¹

It is also the case that, in many countries in Europe and in North America, a part of the risk that farmers would normally face has for many years been

* A version of this paper was presented to a seminar on Farm Risk Management of the Nordic Association of Agricultural Scientists, Sections for Agricultural Economics and for Education and Extension, Oslo 14-16 June 2006.

1. When I started my professional career in farm management research in 1958, addition and subtraction were normally done by mental arithmetic, and multiplication and division using a slide rule or log tables.

removed by generous subsidy schemes and production/market regulations that have protected them against adverse price movements, domestic overproduction and similar ‘disasters’². The best risk management strategy for farmers in such a political environment was, and in some cases still is, to lobby hard for more subsidies whenever the going gets tough, rather than to learn how to manage risk themselves. These cosseted farmers now face the risk that the evolving politics of international trade may oblige their governments to remove the subsidies, at least those paid in proportion to the scale of production.

Despite the earlier neglect of risk in farm management, the theory of risky choice is not new. Daniel Bernoulli propounded the elements of what is now expected utility theory as long ago as 1738. But his work went largely unnoticed until it was rediscovered by the famous mathematician John von Neumann and his colleague Oscar Morgenstern in 1947. They reinterpreted Bernoulli’s idea in a more accessible way, in particular, in English, not in Latin, and they set out the foundations for rational choice under risk in terms of expected utility.

Soon thereafter the expected utility hypothesis was given a subjectivist twist by Leonard J. Savage in his *Foundations of Statistics* (1954). Drawing on the earlier work of Frank P. Ramsey (1926) and Bruno de Finetti (1937), Savage formulated the subjective expected utility (SEU) hypothesis, which is central to most modern approaches to rational risky choice.

The idea of SEU is simple enough – it implies that, when faced with a risky choice, a decision maker should act consistently with what he or she believes about the uncertainty to be faced and with his or her relative preferences for the possible consequences – surely not a controversial proposition. Operationally it means breaking down the judgements needed to analyse an important risky decision into two parts:

1. an assessment of the decision maker’s beliefs about the uncertainty of the possible consequences, measured as the decision maker’s subjective probabilities; and
2. an assessment of the decision maker’s relative preferences for those consequences, evaluated via the decision maker’s utility function.

Then the two elements are combined to compute the subjective expected utility, leading to choice of the best option as the one with the highest utility value. The combination of these two elements is what I shall call decision analysis, a term coined by Ronald Howard in 1966 and latter applied to risky choice in agriculture by Anderson *et al.* (1977). For some recently published reminiscences about the early heady days in the development of decision analysis see Raiffa (2002) and Smith and von Winterfeldt (2004).

The theoretical notion of a utility function to encode preferences for income or wealth was one long familiar to economists, but application of the SEU hypothesis required actual functions to be elicited from decision makers.

2. In 2004, the countries of the Organization for Economic Cooperation and Development (OECD) spent a total of \$280 billion on agricultural support programs (<http://ocde.p4.siteinternet.com/publications/doifiles/012005061T011.xls>).

Some of the early applied work was done with farmers (e.g. Officer and Halter 1968, Binswanger 1980). The shape of a utility function for money or wealth reflects the attitude to risk, with risk aversion showing as diminishing marginal utility (i.e. increasing at a decreasing rate). However, because utility was measured on an arbitrary scale, like temperature, it was at first unclear how risk aversion could be quantified and compared. John W. Pratt (1964) and Kenneth J. Arrow (1965), apparently independently, came up with the same way of deriving measures of relative and absolute risk aversion to overcome this difficulty.

The development of ideas about probability has an even longer history than for utility. For a readable account see Bernstein (1996), although he gives rather limited attention to subjective probability. Raiffa (1968, ch. 11) provides a good summary of some of the same historical literature from a subjectivist viewpoint. The concept of subjective probability can best be explained using a reference lottery (Raiffa 1968). Suppose you wish to assess your probability that some uncertain state of the world S will eventuate. Consider a lottery, such as a bag containing a large number of coloured counters, some red and some black. You are offered a choice between two risky alternatives:

1. you win a valuable prize if S happens; or
2. you win the same prize if a single counter drawn at random from the bag turns out to be red.

The proportion p of red counters in the bag that makes you just indifferent between these two risky prospects is your subjective probability for event S , i.e. $P(S) = p$.

It is clear from this definition that subjective probabilities are matters of personal judgment, meaning that different people can legitimately assess different probabilities for the same event. On the other hand, it is also clear that probabilities must obey some rules, such as being numbers (proportions of red counters) between zero and one, and that the probability of S not happening must be $1 - p$ (the proportion of black counters). Extending to events with multiple possible outcomes, probabilities must be numbers between zero and 1.0 and must sum to 1.0 over all possibilities. Moreover, subjective probabilities should obviously also be consistent with the assessor's other beliefs, so that, for example, if there is abundant evidence about some uncertain event, the assigned probability should reflect that evidence.

Note that p is not the 'true' probability that S will happen; the true probability is either 1.0 or zero, since S either will or will not occur. The problem is that beforehand we do not know which, so, if S matters in affecting the consequences of some risky choice, we have to make a prior subjective assessment of the chance that it will occur.

Building on Savage's contribution, a number of workers, mainly in US business schools, began to put the theory of subjective probability onto an operational footing, usually as part of applying the SEU approach to risky

choice (e.g., Schlaifer 1959, Raiffa and Schlaifer 1961, Pratt *et al.* 1965, Staël von Holstein 1970).

Discomfort with the use of wholly subjective probabilities led to the development of statistical methods to revise such 'prior' assessments systematically in the light of empirical evidence in order to derive 'posterior' probabilities that integrated prior subjective beliefs with empirical or other evidence (e.g., Hadley 1967, Winkler 1972). These methods are based on an uncontentious theorem of probability proposed by an English clergyman, Rev. Thomas Bayes and published posthumously in 1763. Bayesian probability revision now comprises an important and still evolving branch of statistical theory and methods.

Apart from a few early efforts such as Freund (1956), the application of decision analysis to real risky problems was mainly pioneered in the 1960s at Harvard and other US business schools (Raiffa 1968, Schlaifer 1969). These methods soon began to be extended to agriculture, including farm management (e.g., Halter and Dean 1971, Dillon 1971, Anderson *et al.* 1977, Barry 1984)³. For a discussion of recent applications in areas other than agriculture, see Keefer *et al.* (2004a, b), Cantor, (2004) and Hämäläinen (2004).

Accounting for risk in decision analysis typically involves much more computation than pretending no risk exists. The computer and software revolution that really got moving in the late 1980s and early 1990s, proceeding apace since then, has dramatically changed what is possible in applied decision analysis. An analysis that required hours of computer programming in the 1960s and 70s can now be done more or less with the click of a mouse (e.g., Morgan and Henrion 1990, Clemen 1996, Harwood *et al.* 1999, Vose 2000, Hardaker *et al.* 2004a).

The present

Unresolved theoretical issues

Contrary to what the above brief historical overview might suggest, there is by no means unanimity about the theoretical foundation and practical application of decision analysis. While some of the opposition can be put down to conservatism, some of the criticism is thoughtful and well-informed, so has to be taken seriously.

There has been much debate, perhaps too much, about the validity of the basic Bernoullian expected utility theory. It has been noticed that people often do not act consistently with the theory, which surely is not in itself surprising. Risky choice is tricky and the effort to act rationally and consistently may not be worth it, especially for minor decisions. We take short cuts that can lead to less than wholly sensible choices. Formal analysis for decision support would be pointless if farmers and others always acted rationally without it. But when the inconsistency with theory is marked and when it is persistent, even when seemingly irrational behaviour is pointed out to the decision maker, it is a

3. I was lucky that, when I took up a position at the University of New England in Australia in 1967, I joined a group of outstanding young academics who were enthusiastically exploring the scope for applying decision analysis to agriculture. I owe much to my two closest colleagues of those days, Jock Anderson and the late John Dillon.

worry (Rabin 2000, Rabin and Thaler 2001).

It is clear that, at least for some risky decisions, most of us evaluate the consequences with a narrow perspective. So, for example, we do not see losses and gains as changes in wealth (which is what they really are), but rather react in a very averse way to possible losses. Such loss aversion, also called failure in asset integration, is certainly real in some contexts, but it can be seen to be irrational, at least for business decision making. The irrationality is most obvious in relation to repeated decisions with positive expected values but some risk of modest loss. Over many such choices the risk of overall loss declines and expected total profit grows as the number of decisions increases. It is by taking lots of such small risks with better than fair odds that the owners of casinos get rich. It follows that a farmer who takes day-to-day or even year-to-year decisions in a very loss-averse fashion would at best forgo some reasonably secure profits, and could well go broke in the longer run in the face of competition from other producers who are less overly cautious and hence more successful.

To avoid the pitfall of loss aversion, a sensible farmer will take a broader view of risks, setting them in the context of the overall asset position of the business. While all risks matter and some caution is wise, only risks that threaten the asset base need to be taken very seriously. I suggest that it follows, therefore, that asset integration makes sense for prescriptive decision analysis and loss aversion does not. In practice, this means that risky choice is usually best analysed by considering the payoffs as changes in wealth, making appropriate adjustments to the degree of risk aversion when the payoffs are expressed as losses and gains, or as transitory income (Anderson and Hardaker 2003).

The assumption that asset integration makes sense is at odds with the view of Newbery and Stiglitz (1981) in their study of price stabilisation in agriculture. They concluded that the asset integration assumption did not describe the way farmers viewed risk in annual income. They may have got it right for modelling behaviour, although I remain somewhat sceptical. The apparent reluctance of many farmers to pay for crop insurance, even when premiums are subsidised, seems to suggest that they do think about some risks in a strategic way. There is little doubt that, like the rest of us, farmers are influenced by the context of a risky choice, making it difficult to generalise about their risk-taking behaviour.

Some alternatives to the SEU theory of risky choice have been developed that are claimed by their proponents to better reflect how people actually make risky decisions (e.g., Kahneman and Tversky 1979, Quiggin 1993). According to Starmer (2000), the question of which theory is best in explaining behaviour remains unresolved. However, there is considerable support for my view that SEU is the best theory to guide prescriptive choice, even though it may not be the best way of explaining actual behaviour of farmers or others (e.g., Machina 1987, Edwards 1992 and, among agricultural economists, Meyer 2001 and Just 2003).

Unfortunately, even if Bernoullian utility can be argued to be best for some uses, the introspection required of decision makers to derive their utility functions defeats many people. With a well-motivated decision maker, for

example one seeking advice about a specific risky choice, it is often possible to elicit at least an order of magnitude of risk aversion, if not a full utility function, with reasonable confidence. But otherwise the reality is that elicitation of utility functions, especially from survey samples of farmers, is seldom convincing (King and Robison 1984, Anderson and Hardaker 2003). (The alternative theories of choice have for the most part not been tested to the same degree, but my guess is that they too would prove to be at least as hard to implement.)

Fortunately, the difficulties in utility function elicitation are not as severe as is sometimes argued because:

- There is growing recognition that risk aversion (but not risk itself) is less important than is commonly believed, at least for most partial or short-term risky decisions by capitalist farmers such as those in the more developed countries (Pannell *et al.* 2000, Lien and Hardaker 2001). Here I refer mainly to those decisions that influence only (a part of) farm income in the current or following year, and, importantly, I am assuming asset integration and good access to bank finance when needed. (Certainly, the consensus is that risk aversion should seldom be given much importance for most public policy decisions, mainly because such risks can be spread widely across the whole population, at least potentially (Arrow and Lind 1970)). It seems, therefore, that for many decisions, though not all, maximising subjective expected money value will be good enough.
- For many decision problems with a few discrete options, the best choice often is not sensitive to differences in degree of risk aversion over a plausible range. Even when the best choice does shift with degree of risk aversion, the cost of picking a second or third best option is often small, again for some but not all decisions.
- Even if a precise utility function is not available, for example when access to the decision maker is not possible or when seeking to make recommendations for many decision makers, progress can still be made in decision analysis using risk efficiency methods such as stochastic efficiency with respect to a function (SERF)⁴ (Hardaker *et al.* 2004b). Such methods are increasingly accepted as good ways of culling out less risk-efficient options in order to present a small set of risk-efficient options for a decision maker to make a final selection, and obviating the need for a specific utility function. These methods can also be used to test and verify or occasionally refute the above assertions about the relative unimportance of risk aversion in risky choice.

Note that the assertion above that risk aversion is often not very important does not mean that risk does not matter in farmers' decision making. Risk matters because it costs farmers money when things go wrong, sometimes a lot of money. Budgeting for the future on the basis that everything goes according to plan will often be misleading, since in farming, as in life, things seldom go according to plan. Budgets constructed under assumed certain with

4. In SERF alternative risky prospects are compared in terms of their certainty equivalents for a plausible range of risk aversion. The method is both simpler and more discriminating than most other methods of stochastic efficiency analysis.

coefficients chosen to represent ‘most likely’ values or ‘best estimates’ can lead to over-optimistic choices. The reason is that Nature tends to be unkind to farmers, in the sense that what they gain in the good times seldom compensates for the losses in the bad times. Moreover, this effect tends to be magnified by the dynamic and sequential nature of farm decision making. A bad outcome today often limits the scope to reap full benefit from future more favourable conditions. Hardaker *et al.* (2004a) somewhat unconventionally, call this effect *downside risk*. Downside risk needs to be thought about in farm planning and ideally incorporated into planning models using an appropriate form of stochastic analysis such as stimulation. Some recent catastrophes around the world, from Iraq through hurricanes to tsunamis, illustrate how important downside risk can be if the tasks of planning and preparation for risky events are done badly.

Assessing probabilities

The focus on utility and its limitations seems to have diverted the attention, at least of agricultural economists and farm management professionals, away from the more important issue of making good probability judgments. Most practitioners were reared on a definition of probability as (the limit of) a relative frequency ratio. Such probabilities are often called ‘objective’ probabilities because they are calculated from data that are assumed to be reliable and relevant to the uncertainty to be addressed (subjective judgments in themselves). Subjective probabilities may therefore be seen, especially by proponents of the relative frequency school of thought, as being the opposite of ‘objective’. Nothing could be further from the truth. At least for important risky choices, assessed subjective probabilities need to be carefully and rationally considered, including an examination of what data or other information may be available or could be worth collecting. It might have been better, and would have caused less confusion, if Savage had called them ‘considered’ rather than ‘subjective’ probabilities.

It is self evident that, when there are abundant, relevant and reliable data bearing on some uncertain phenomenon of interest in a decision analysis, the decision maker or analyst would be foolish not to base probability assessment on the relative frequencies reflected in the data. In that sense, relative frequency probabilities are a sub-set of subjective probabilities⁵. The difference comes when relevant frequency data are lacking, and cannot sensibly be collected. Then those who limit their definition of probability to relative frequencies must throw in their hands, while subjectivists set about the task of deciding how best to form a rational judgement in this admittedly far from ideal – but all too common – situation. There is a large and evolving literature on how to make good subjective probability judgments in zero or sparse data situations. Hardaker and Lien (2005) have tried to synthesise some general principles of good practice for decision making in agriculture from this literature.

Agricultural economists and farm management researchers with the

5. The same goes for logical probabilities, as when assigning equal probabilities to heads or tails from a single toss of a coin known or believed to be ‘fair’ (Carnap 1962).

relative frequency view of probability ingrained into their minds typically attempt risk analysis only for problems where there are abundant, though, sadly, often somewhat irrelevant, data. For example, it is not unusual to see cross section data on, say, crop yields, used to represent farm-level risk; a practice which is both illogical and potentially misleading since the actual risks are likely to be seriously underestimated. Moreover, it is rare to come across data-based decision analyses where the inadequacies of the data are discussed. Indeed, it seems few analysts even realise that, at the very least, they are making an assumption of stationarity when estimating probabilities for decision analysis from historical data, i.e., they are presuming that future risk is adequately represented by past variability. Yet we know that the world of agriculture is not stationary, due to such effects as global warming, technological change, shifts in consumer demand and evolving political priorities, so that the future may contain events that have never happened before. Moreover, the implicit assumption that the farmer has the same perception of future risk as that derived by the analyst using some subjectively selected sub-set of historical data is a strong, even heroic one.

The subjective view of probability also provides, via Bayesian logic, a means of deciding when it will be worthwhile to collect data of various sorts, including relative frequency information, to improve initial subjective probability judgments. Such an approach may well lead the subjectivist to garner more information than would a proponent of relative frequency probabilities who focuses only on historical data. Moreover, as Just (2003) has stressed, researchers who recognise that risk matters should put more effort into getting relevant and reliable data. New methods of data collection such as electronic monitoring have reduced dramatically the costs of collecting some sorts of data, some of which are potentially useful for decision analysis. In other cases, changes to the way some kinds of data are collected could make the information more useful for risk analysis. For example, in farm accounting surveys, panel data extending over several years are much more useful for assessing probabilities than are single-period cross-section studies.

Even with better data for decision analysis becoming available, analysts will inevitably have to learn to cope with sparse or zero data situations if their work is to have practical relevance, especially in analysing the potentially catastrophic risks that have not yet happened, such as the possibility of an outbreak of an exotic animal disease or the loss of a major market for some farm product.

In cases where there are some relevant relative frequency data, the sample sizes will often be small. Then it will be important to look at how to extract as much information from the sample data as possible, combining the data with relevant information such as knowledge about the feasible range of the uncertain quantities of interest. Some subjective judgments will always be entailed, typically as part of a process of data smoothing (Anderson, 1974, Hardaker *et al.* 2004a, pp. 64-71, Richardson *et al.* 2006).

When relative frequency data simply do not exist and cannot economically be collected, analysts need to turn to the available literature for guidance on how to devise a process to get the best, most rational, probability assessments they can. To take just one example, suppose a corporate investor is proposing

to establish a large-scale, intensive farming business in an EU country. The investor is worried, however, that existing support arrangements for agriculture might be discontinued or seriously curtailed to such an extent as to make the investment unprofitable. How could the entailed risk be assessed? Clearly, there are no relevant relative frequency data that can be brought to bear on the issue. Yet the risk is surely too important to do nothing.

If we were responsible for assisting in the analysis of this significant risk, what should we do? That is a question worthy of much debate, but I suggest that it would be wise to consult people knowledgeable about the ongoing negotiations at the WTO, people well informed about the political situation and outlook in the country concerned and in Brussels, economists to advise on direct and indirect impacts of changed support arrangements for agriculture, and farm management experts who could advise on the effect on profitability of potential changes in price regimes. Moreover, it would be wise to consult more than one expert in each field and to get them to exchange and discuss information and predictions, but only in ways that would avoid known pitfalls of group dysfunction⁶. Those assigned with the task of making specific probability judgments might with value first be given careful training in such tasks to minimise the possibility of some well-known forms of bias. For example there is a well-documented tendency for people to make their assessed distributions too 'tight' – most of us tend to be too confident about what we think we know. Calibration of assessed probabilities using proper scoring rules can be used to help assessors improve their judgments (e.g., Matheson and Winkler 1976). For more extensive information on bias in probability assessments, see, e.g., Tversky and Kahneman (1982) and Plous (1993). Some suggested principles of good practice have been outlined by Hardaker and Lien (2005).

In summary, improving decision makers' and analysts' understanding of, and comfort with, the wise use subjective probabilities, and incorporating ways to improve these probability judgments, remain as uncompleted tasks. They require analysts to make choices about the processes of probability assessment in more systematic, transparent and responsible ways. While the existing literature offers some guidance and warns against some significant errors in methods, there is scope and need for the development and evaluation of new and better procedures for probability assessment, both generally and specifically for agricultural and farm management applications.

In farm decision analysis it is the farmer who needs to be satisfied that the probability judgments are as rational as possible. For farm advisers, therefore, the test of their efforts lies in the extent to which they are believed by their farmer clients (and later by how well their recommendations pan out as uncertainty unfolds). The task of getting widely acceptable probabilities for policy decision making is more difficult. In particular, there is an ongoing debate about how decision makers and their advisers should respond to public perceptions of risk. Because of some fiascos such as BSE in Britain and in some other countries, there is a substantial degree of public distrust of 'expert'

6. The US Senate Intelligence Committee (2004) blamed the phenomenon of 'groupthink' for failures to interpret correctly intelligence relating to Iraq's supposed weapons of mass destruction. It is a pity that those making this important assessment were not alert to this known trap (see e.g. Baron 2005).

risk assessments. It was known as long ago as 1978 that public risk perceptions are often conditioned by a range of additional factors such as 'dread', 'involuntariness', 'controllability', 'lack of knowledge of those exposed' and 'catastrophic potential' (Fischhoff *et al.* 1978, Slovic *et al.* 1985). For example, people may rate the health risk of eating GMO foods higher than the risk from smoking, because GMOs are 'imposed' and smoking is seen as 'voluntary'. Yet most experts would say that the relativities in riskiness are strongly the other way. A consensus seems to be emerging that experts are not always right and that, in any event, more consultation between experts and stake-holders is needed. Slovic (1999) summarises the situation well, observing that research shows the inadequacies of the traditional view of risk assessment as 'scientific' when it is inherently subjective. He notes that views of both the public and experts are influenced by their respective world views, ideologies and values. He advocates the need for more public participation in both risk assessment and decision making. It would seem that in many of the issues to do with food safety and with environmental risks, to name but two, there is a need for farmers and others close to agriculture to engage more fully with both the general public and with policy makers to contribute their special perspectives on the nature and importance of agriculture-related risks and their management.

Advances in methods of decision analysis

In terms of methods of decision analysis, most changes in recent times have been small skirmishes at the frontline of existing set of techniques. For example, there have been scores of studies proposing various mathematical programming formulations for dealing with risk in whole-farm planning. In my view, none of these has added much to the methods available long ago (Freund 1956, Rae 1971, Lambert and McCarl 1985, Patten *et al.* 1988).

The ready availability and ease of use of stochastic simulation has certainly been an important advance. Farm budgeting and planning got a lot easier with the advent of spreadsheet software, and now it can be almost trivial to make these budgets stochastic with spreadsheet add-in software such as @Risk from Palisade, Crystal Ball from Decisioneering or Simetar from Simetar Inc. Similarly, software for the development and analysis of decision trees, such as DATA from TreeAge or Precision Tree from Palisade, has made it possible to structure and solve much more complex risky choice situations than was possible in the days of pen and large sheets of paper. Unfortunately, this very ease of use has led to some errors in application, notably the tendency to ignore stochastic dependency. When two or more uncertain variables are not stochastically independent (e.g. they are positively or negatively correlated), ignoring the stochastic dependency is likely to produce erroneous results in terms of the probability distribution of returns. Better methods of modelling stochastic dependency are emerging, creating a challenge to communicate these to users (e.g., Clemen and Reilly 1999, Richardson *et al.* 2000, Cherubini *et al.* 2004).

Chambers and Quiggin (2000) have added some important new perspectives to both theory and application in a recent book about state-

contingent methods for decision analysis. Unfortunately, they tell their story in a mathematically opaque way, making it hard to be sure just what impact their ideas will have on practice. However, it seems that their main contribution is to show how risk can be represented using discrete states in a way that brings it within the purview of conventional economic theory, with all the advantages that implies, such as the ability to calculate shadow prices (Rasmussen 2003, 2006). At present, it seems that the main benefit will come in econometric work accounting for risk (Quiggin and Chambers 2004, O'Donnell and Griffiths 2006). In particular, using the state-contingent framework in estimating production functions makes it easier to account for the fact that some input levels are fixed in advance of the unfolding of the uncertainty while others can be varied according to the state that eventuates. Unfortunately, accounting for this more realistic representation of production decisions will be more data-demanding and may require some new methods of model estimation.

Of course, many farm decision analyses in the past have been done in what is essentially a state-contingent framework, such as is used in discrete stochastic programming for farm planning. The insights that come from the contribution by Chambers and Quiggin for such work may well involve no more than a slight recasting of the way the models are structured together with clearer understanding of how the interpretation of the results can be extended. However, it will be a while yet before it becomes clear just how important this innovation will be for practitioners of decision analysis.

Emerging ways of managing risk

An important evolving area is the expanding market for risk which allows farmers and agribusinesses (among others) to trade away unacceptable risks. The desirability of such developments was clarified by the pioneering work of Kenneth Arrow, who won the Nobel Prize for Economics for his studies of insurance and other risk-sharing instruments. It seems to me that presently this thrust is advancing two fronts:

- 1 The development and progressive refinement of commercially viable 'risk instruments' - essentially traded contracts in risky events. So it either already is possible, or is becoming so, not only to buy (and sell) insurance for an expanding range of risks, but also to trade in derivative products such as commodity futures to hedge price risk, or weather derivatives to hedge against drought or other extreme weather. There are even emerging markets to trade political risks, such as which party might form the next government or whether Norway will join the EU.

The markets for some of these products are rather 'thin' and many of the contracts that are written are 'commercial in confidence' so it is hard to judge the scale and pace of developments. It seems, however, that there was a significant set back with the failure of some large risk management businesses a few years ago. But, as those events fade into the past, I hope to see progress accelerating, with more and better

designed contracts being developed and marketed.⁷

Many farmers might benefit from integrating use of derivatives into their overall risk management plans. Yet to date, the uptake of the use of derivatives by farmers has generally been low, being largely confined to a few large corporate businesses. However, farmers may still benefit when suppliers of farm inputs or buyers of farm outputs are able to hedge risks on these derivative markets in order to offer their farmer clients secure, longer term contracts that eliminate some of the risks to farm income.

2. Growing interest on the part of many governments in the use of agricultural insurance as a substitute for price support, which is looking less and less sustainable under evolving WTO negotiations. It seems that many governments see subsidised crop insurance as a means (a) to help farmers manage risk better and (b) to prop up farm incomes in order to buy rural votes. Unfortunately, as experience with the US crop insurance program shows, the two objectives tend to be conflicting. Subsidising insurance distorts farmers' incentives and leads to inefficient resource allocation on farms, without making things much better for farmers, at least in the long run - the subsidies, like all subsidies, get capitalised into land values, so returns on capital in farming fall back to levels that would apply without them (Skees 1999).

I believe that most government efforts to develop new forms of risk sharing are counter-productive. There is no successful government-sponsored crop insurance program in the world, as far as I know, that is not subsidised. Yet subsidised insurance schemes are usually a bad idea, partly because they are distorting, but also because they tend to 'crowd out' the evolution of sound commercial risk-sharing products.

Prospects for the future

Crystal-ball gazing is always tricky and a wise fortune teller will either so choose the words of the forecast that they can be interpreted to appear to describe whatever happens, or will deal with the far and indefinite future, or both. That would not be interesting, so I am not going to try to foretell the future. I am on much safer ground by restricting myself to what I would like to see happen.

First, I'd like to see more risk analysts, in agriculture and generally, recognising and using subjective probability as the language of uncertainty. The more communication there is between 'experts', stakeholders, advisers and policy makers about risks in agriculture, and the more explicit and quantitatively precise that communication is, the better will be the general understanding of risk. That has to be a good thing.

Second, I'd like to see much more systematic analysis being done on the

7. The apparently rather thin market for agricultural derivatives contrasts with the huge general market in swaps, derivatives and other complex instruments for risk transfer. For example, *The Economist* magazine of 27 April 2006 reported that, from small beginnings in 1987, the face value of contracts in interest-rate and currency derivatives is now more than \$200 trillion - 16 times the US GDP.

most serious risks farmers face, with less time spent in largely futile academic efforts to analyse relatively minor risks, chosen simply because, in the main, these are the only ones for which relatively abundant and more or less relevant data exist. Big risks come in various forms, partly depending on individual farm circumstances. But included are:

- risks of major disease and pest outbreaks, such as BSE, foot-and-mouth disease or crop blights;
- institutional risks, such as reductions in farming subsidies, collapse of markets for such reasons as political pressures, changes in quarantine or food safety rules, the introduction of more severe environmental protection, animal welfare or taxation regulations, etc.;
- risks associated with major farming investments involving sunk costs, such as purchase of a farm or extra land, construction of expensive buildings;
- risks of natural catastrophes such as seismic events, prolonged droughts, unusually severe winter conditions, floods, etc.;
- risks to the health and wellbeing of the farm family from accidents, illness or breakdown of relationships; and, arching over all these categories,
- the risk of financial failure, which is magnified the more indebted is a farm business, emphasising the importance of sound financial management in a risky world.

If the big risks, including the ones for which usually there are few or no relevant data because they are rare or new events, are to be tackled systematically, there will be a need to adopt much more professional approaches to subjective probability assessment. With some significant exceptions, agriculture seems to be lagging in the risk assessment business, and it is time that changed. Such change will require a paradigm shift for many of the workers in the field, and that is not going to be easy to achieve (Kuhn 1970). But there are signs of more challenges emerging to the old paradigm based on the relative frequency school of probability. Rather few of these efforts appear in the mainstream professional literature because such papers seldom attract the approval of conservative reviewers and editors. But in the field I have seen some good work based on subjective probabilities, some done by commercial consultants rather than academics or professional researchers.

At meetings and in other discussions I have been encouraged to discover that there are practical people around wanting to tackle the data-sparse but important risky choices in agriculture, but too often they are discouraged by criticism from their professionally arrogant but in my view misguided relative frequency colleagues. I hope that by these comments I have encouraged anyone who has encountered such a situation to have the confidence to persist, despite opposition. That way lies real progress in better tackling the risks that really matter to farmers, governments and all of us.

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REFEREED PAPER

**HELPING FARMERS ADJUST TO POLICY REFORMS
THROUGH DEMONSTRATION FARMS: LESSONS FROM
A PROJECT IN ENGLAND¹**

A P Bailey, C J Garforth, B Angell, T. Scott, J Beedell, S Beechener and R B Rana

Market pressures and policy changes have heightened interest in knowledge and technology transfer in English agriculture. This paper reports the results of an evaluation of a government funded project, Forward Farming (2002-2004), which examined different ways of using demonstration to encourage change at farm level. The evaluation found that, while there is a strong economic argument for public funding of demonstration, this does not necessarily require a permanent network of fixed farms.

Key words: knowledge transfer, demonstration farms

Knowledge transfer in government policy

Agriculture within the EU has seen many changes over its 50 year history, the most recent being the current Common Agricultural Policy (CAP) reform moving towards the full decoupling of support from production activity. Farmers and their businesses have had to adapt to these changes and have done so in many different ways. Knowledge transfer mechanisms (Garforth *et al.* 2004) are one set of instruments to facilitate change in farmers' approaches to the management of their businesses. They address a number of areas, including helping farmers to maintain and update their production expertise, identifying opportunities for diversification, and advising on environmental requirements and opportunities.

Knowledge transfer has often been conceptualised as the passing on of new research-based knowledge to farmers in the form of advice and recommendations for changes in the way they farm and manage their enterprises. Recent thinking on how change occurs at farm level emphasises adaptation and co-learning as more realistic ways of conceptualising the process by which farmers acquire new knowledge and put it into practice (Leeuwis 2004; Engel 1997).

Notions of learning, i.e. acquiring knowledge, rather than transfer recognise that opportunities for observation, interaction and discussion play an important role in farmers' decisions, prompting interest in both on-farm demonstration activity and monitoring of farm businesses as potentially effective knowledge transfer interventions. Research on the adoption and diffusion of innovations has consistently confirmed that one of farmers' most commonly cited sources of information and ideas is other farmers (Rogers 1995).

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Forward Farming – a pilot demonstration farm project

Recent UK government intervention in agricultural knowledge transfer has included the Department for Environment, Food and Rural Affairs (Defra) cross-cutting Learning, Skills and Knowledge (LSK) programme (Defra 2004).

A key concept within the LSK programme was helping rural businesses to learn from each other (Defra 2004). A pilot Demonstration Farm network, implemented by the ELITE² consortium of land-based further and higher education colleges under the label “Forward Farming” from mid-2002 to mid-2004, was one of the elements of the programme aimed specifically at the farming sector. Defra’s decision to initiate the pilot Demonstration Farm network was a response to a recommendation of the Policy Commission on the Future of Farming and Food (Cabinet Office 2002). The Commission recommendation was based on the perception that the current range of information and advisory services available to farmers was fragmented and of variable quality.

Forward Farming was set up after extensive consultation within the industry on the desirability and form of such an initiative. This consultation, with levy bodies and other stakeholders, led to the decision to test three types of demonstration farm, which became Pilots 1, 2 and 3. Pilot 1 ‘monitor farms’ were to provide and develop economic and environmental benchmarking for the arable, dairy, beef and sheep sectors through on-farm events and the establishment of ‘business clubs’. Pilot 2 ‘demonstration farms’ were designed to illustrate the benefits to farmers of closer links between producers and their markets, local communities, local landscape and the environment. Pilot 3 was a web based virtual demonstration farm for the pig sector designed to demonstrate issues of importance to the industry. Two associated pig industry seminars were also held to provide opportunities for discussion of the topical issues highlighted through the virtual pig farm.

To learn lessons from this initiative, Defra commissioned an evaluation of the Forward Farming pilot and the establishment of a blueprint of principles for the processes required to set up and run a successful demonstration farm/network.³ The remainder of this paper outlines the theoretical framework and approaches used in the evaluation and summarises the findings, before concluding.

Methodology

Evaluating the impact of extension and advisory services is notoriously difficult because of the problems of attribution (Purcell and Anderson 1997). Evaluation models based entirely on quantitative indicators and quasi-experimental research designs have been criticised in the literature for not delivering findings that can inform the design of improved processes (Engel 1997). More informative are approaches that use a combination of quantitative and qualitative methods: the latter allow an evaluation team to explore

2. The ELITE consortium comprises five land-based colleges in England: Bishop Burton, Hartpury, Moulton, Myerscough and Sparsholt (<http://www.elite.ac.uk>, 14/1/2005).

3. Since the planned end of the pilot project, Defra has continued to fund demonstration activities through regional initiatives.

associations in depth from the perspective of the various stakeholder groups. To complete the evaluation of the Forward Farming pilot, a methodology was developed that involved working with the main contractors (ELITE), their evaluation team (Land Use Consultants (LUC)), participants and non-participants, and other stakeholders in the project and industry (Angell *et al.* 2004). The multi-method approach used in the evaluation process emphasised the importance of the perceptions and perspectives of different actors (Madsen and Adriansen 2004).

An early task was to clarify the role of the evaluation vis-à-vis the ongoing 'evaluation of impact' work of LUC. This was done by drawing up a logical framework for the Forward Farming pilot. Logical Framework Analysis (LFA) captures the essential structure of a project in terms of inputs, activities, outputs, purposes and wide goals, and can be used for both monitoring implementation (the transfer of inputs into outputs) and evaluation (assessing the achievement of purposes and goals). The logical framework formed the basis of identifying the respective roles of the evaluation team and LUC and how data from the latter could contribute to the work of the team. Thus, information for the indicator values came from ELITE's own monitoring work (conducted by LUC) and surveys and discussion initiated by the evaluation team.

Interviews with stakeholders were the main source of qualitative information on the processes of the Forward Farming pilot. First, interviews with local stakeholders, facilitators, and host farmers involved with the pilot were conducted. Second, to capture a wider range of issues, in depth interviews were conducted with five key national stakeholders (LEAF, Home-Grown Cereals Authority, Milk Development Council, Small Business Service, Meat and Livestock Commission) and Defra. Third, letters soliciting written feedback were sent to a further 41 named individuals in stakeholder organisations, ranging from agricultural colleges to professional and trade organisations, government bodies and non-governmental organisations (NGOs). Interview guides, to be used with stakeholders at all levels of the pilot, were designed by the project team, in light of the study objectives and information received from ELITE and LUC. Issues covered included the role of demonstration farms, alternative models of knowledge transfer, ownership and funding, initial set-up, selection and management of host farms, selection and management of events, outcomes and links.

Using the qualitative data from the series of interviews and the written consultation, actor linkage analysis (Biggs and Matsuert 2004) was used to evaluate how well the institutional relationships around the demonstration farms were working and also to locate the demonstration farms within the broader agricultural knowledge and information system.

A telephone survey, within the framework of the Theory of Planned Behaviour (TPB), was also conducted with attendee and non-attendee farmers⁴ of the Forward Farming events. TPB (Ajzen 1991) is a social-psychology framework for understanding and predicting behaviour by measuring the underlying determinants of that behaviour: attitudes, subjective norm and perceived behavioural control, i.e. the extent to which individuals feel they are

4. ELITE provided contact details for the attendee sample, Defra provided contact details for the non-attendee sample.

able to put their intentions into practice. The telephone survey and associated questionnaire was designed to generate quantitative data on farmers' attitudes and intentions towards demonstrations and their reasons for (i) attending/not attending, and (ii) using/not using information gained from the demonstration farms. Two interview schedules were used, the first for Pilots 1 and 2 and the second for Pilot 3. These were piloted on 14 attendee and non-attendee farmers, and then used to develop a brief fully structured questionnaire (adapted slightly for Pilot 3) capable of being administered by telephone in a 10-15 minute interview. The target for the survey sample, set by the client for the evaluation, and stratified according to farm size, type and location, was 360 individual farmers/farm businesses, comprising 180 attendees and 180 non-attendees. These were further split between Pilot 1, Pilot 2 and Pilot 3.

Information maps, using data from the farmer and other interviews, were drawn up to explore how farmers view the demonstration farms in relation to all their other actual and potential sources of information. Information mapping is a process that explores how farmers and others view a particular source of information in relation to all their other actual and potential sources of information (Garforth 2001). The mapping process is used to illustrate the extent of immediate interaction with each source and the level of influence that that source has.

To complete the evaluation case study comparisons of six other demonstration farm networks (Table 1), four from the UK and two from overseas, were then undertaken to compare the objectives, nature and level of outputs against the Forward Farming pilot. The structure for analysis and

Table 1. Case studies selected for comparison with Forward Farming

	Case study	Description
1	Linking Environment and Farming (LEAF) Demonstration Farms	40+ volunteer farms throughout the UK demonstrating Integrated Farm Management to LEAF members, other farmers and members of the public.
2	Farming Connect Wales Demonstration Farms	Network of 3 development centres, 11 development farms and 23 demonstration farms, to facilitate technology transfer from research and encourage best practice and improved business performance.
3	Inside UK Enterprise (IUKF) – Farming	Programme of one-day visits to 29 selected farms in England that have improved their business and/or environmental performance, which clients of the Farm Business Advisory Service can join free of charge.
4	The Arable Group (TAG)	Field days (c. 100 per year) to 24 centres in the main arable areas of the UK where trials of varieties, agronomic practices and farm inputs are conducted on behalf of subscribing farmers.
5	Teagasc Monitor Farms	120+ monitor farms throughout Ireland, providing the focus for 500+ discussion groups who meet on each other's farms to discuss the performance of new technology and practices and their potential application on their own farms.
6	Wool and Meat Innovation (WMI) Monitor Farms, New Zealand	c. 30 monitor farms in the main livestock regions of the country, each supported by a local facilitator, through which community groups analyse and learn from a three year process of planned change on the farm

reporting used a logical framework to be comparable with the structure used in the Forward Farming evaluation. Data were compiled from existing evaluations, papers and reports, and telephone interviews with key informants involved with the networks.

Finally, the integration of findings from all strands of work allowed the development of the blueprint of principles. This was then tested with farmers in two focus groups and subsequently with national stakeholders in a consultation workshop.

Results⁵

The LFA showed that Forward Farming shared with the six comparator networks an overall goal of sustainability, although there were different emphases on the individual farm business, the agriculture sector and the rural economy as a whole. For example, the purposes emphasised by the different case study networks included business performance (Farming Connect, IUKE-Farming, WMI), more operational concerns (LEAF, TAG, WMI) and research transfer (Teagasc). The Forward Farming pilots emphasised economic and environmental benchmarking (Pilots 1 and 3) and supply chain and local community relations (Pilot 2). The immediate outputs expected from demonstration and monitoring activities, in all cases, were a blend of awareness, knowledge of how to implement changes and motivation to effect change.

Data on participation in the Forward Farming activities from ELITE and LUC covering attendance and event evaluation and feedback, supplemented by the evaluation interviews and consultations, provided information on the activities and the levels of participation in the demonstration farm events and associated activities including the business clubs.

The majority of the farms in the Forward Farming Pilots 1 and 2 held three events across the year. The comparator networks, with a similar set up, held four or more events, although the diverse nature of the different networks makes comparison difficult.

For Pilot 1, the attendance at demonstration farm activities averaged 19 attendees per farm event. Repeat attendance increased over time. Pilot 2 attendance averaged 17 attendees per event. The target agreed with Defra was 15 farmers per event. Awareness and use of the Pilot 3 website were low, although increasing. Seventy one farmers attended the first pig seminar: although direct comparison is not possible because it was a very different kind of event from an on-farm demonstration, the ability to attract farmers to the seminar appears greater than for the other pilots.

In comparison with other networks, with an average turnout usually greater than 20 per 'monitor farm' event, attendance at the Forward Farming events was low. Direct comparison should be treated with caution, however, as the comparator networks have been running longer and therefore have had more time to build the confidence and trust required for increased attendance. Further, the numbers attending the Pilot 1 monitor farm events are appropriate for monitor activities, where interaction within a small group is a key feature

5. All empirical data reported here for which no source is cited can be found in Angell et al. (2004): http://www.defra.gov.uk/rural/pdfs/lsc/Demo_Farm_Final_Report.pdf.

of the process. However, the numbers involved in monitoring through the business clubs are lower than those reported from other monitor farm programmes, and few farmers have become involved in formal benchmarking as there are widespread negative perceptions and misunderstandings of what it involves and its potential benefits. Benchmarking, generally, is not a widely understood term although the concept is better established in the dairy sector. Stakeholders in the Forward Farming pilot recognised that farmers required reassurance regarding the use of any data provided and that it would take time for management changes to be reflected in benchmarking information.

ELITE's own monitoring data on actual and planned changes show that most farmers had positive attitudes towards changing their farming practices after attending Forward Farming events (Table 2). The most popular response was to seek further advice or training. In addition, farmers who attended the Pilot 3 pig seminars and the Pilot 1 beef and sheep events indicated change in farm management/trading patterns. Farmers who attended the Pilot 1 dairy events indicated changes involving increased use of benchmarking and increased environmental awareness. Further, attendance at each of the events led to referrals to other activities, and in this respect, it should be noted that demonstration farms and events are but one part of farmers' overall knowledge and information system. They will only contribute to significant levels of change in farm businesses if they support and are supported by other sources of information and advice.

Table 2. Likelihood of change following Forward Farming event.

	<i>Pilot 1 Arable</i>	<i>Pilot 1 Dairy</i>	<i>Pilot 1 Beef & sheep</i>	<i>Pilot 2</i>	<i>Pilot 3 First seminar</i>	<i>Pilot 3 Second seminar</i>
Change farm management /	+0.25	+0.25	+0.41	+0.22	+1.1	+0.63
Increased use of	+0.28	+0.54	+0.38	n/a	n/a	n/a
Increased environmental	+0.25	+0.44	+0.33	+0.25	n/a	n/a
Take up advice / training*	+0.90	+0.98	+0.67	+0.46	+1.1	+0.88
Will definitely attend future FF	54%	58%	54%	42%	79%	62%
Sample base	114	124	117	43	36	71

Data from ELITE/LUC

*Notes: *Mean score based on Yes = +2, probably = +1 and No = -1*

The subsequent evaluation survey by the project team found that 16% of the farmers who attended an event had made changes to their farms or farming practices, and a further 31% were considering making changes in the future. The changes made or proposed encompassed both technical approaches, e.g. changing livestock breed/crop variety, as well as applications for grant funding for, for example, agri-environment schemes. These figures are comparable with the other networks given their longer establishment and lead in times. Of those not planning changes, the reasons given included that the possible

change would not work on their farm (26%), they are doing all the proposed things already (24%) and they were still considering what to do (16%).

The evaluation survey also showed that the majority of attendees at Forward Farming events had attended other demonstration type events within the past year; the majority of non-attendees at Forward Farming events had not. Analysis of the survey data within the TPB framework showed that attendees have more positive attitudes towards attending future demonstration events than non-attendees and the latter were less likely to believe they would derive any benefit from attending. On the other hand the non-attendees did not have any strongly held negative attitudes that are acting as barriers to their attending future events.

The need for demonstration activity and for this to be supported was widely recognised by the stakeholders interviewed and consulted. Demonstration activity was seen to be part of the wider information and advice landscape, although not an activity for its own sake. Rather, it provides a forum for the integration of advice and knowledge available from a variety of sources in a cost-effective way. In relation to this, the stakeholders also held the view that there is already a lot of demonstration activity in the market place and that a large new national network of farms could lead to duplication and confusion, although such a network could play an important role in the provision of integrated farm business and land management advice. In addition, stakeholders were unanimous in appreciating the need for a clear grasp of project objectives to ensure successful delivery. They felt that strategic and 'public good' objectives could be addressed as long as the messages are communicated in a way that is relevant to farmers. The general consensus of the stakeholders was that, if demonstration activity was to receive widespread support nationally, the identification and support of good locally based initiatives and existing high profile networks in the farming community would be the most cost effective use of public funds. Views differed on whether this should be managed centrally or regionally.

The data collected during the face to face stakeholder and attendee/non-attendee telephone interviews was also used to draw up the Actor-Linkage matrix examining the institutional relationships in the Forward Farming project (Figure 1). Each cell represents the link between two sets of actors. Eight sets of actors were identified altogether: host farmers, facilitators, local stakeholder groups, the colleges, Defra, attendees, non-attendees and members of the business clubs. Linkages which are thought to be crucial to the success of a demonstration farm network based on the Forward Farming model are represented by the shaded cells. For example, the host farmer would need to have good communication links and frequent interaction with the facilitator, stakeholder group, attendees and business club members. The assessment of the strength of the linkage within the project is given by the numbers allocated, from no linkage (0) to a strong linkage (3). Analysis of the matrix suggested that the purpose and objectives of the pilot project could have been communicated more effectively at local level, that links between non-attendees and all other actors were very weak and that, at least initially, there was a lack of trust among the potential members of the business clubs which inhibited monitoring and group benchmarking.

Figure 1, Strength of linkages in Forward Farming demonstration plot project.

Actors	Host farmer	Facilitator	Stakeholder group	Elite, Colleges	Defra	Attendees	Non-attendees	Business Club members
Host farmer	1	3	2	2	1	2	1	2
Facilitator		2	3	3	1	2	0	2
Stakeholder group			2	2	1	1	0	1
ELITE, Colleges				2	3	2	0	2
Defra					3	0	0	0
Attendees						1	1	0
Non-attendees							0	0
Business Club members								3

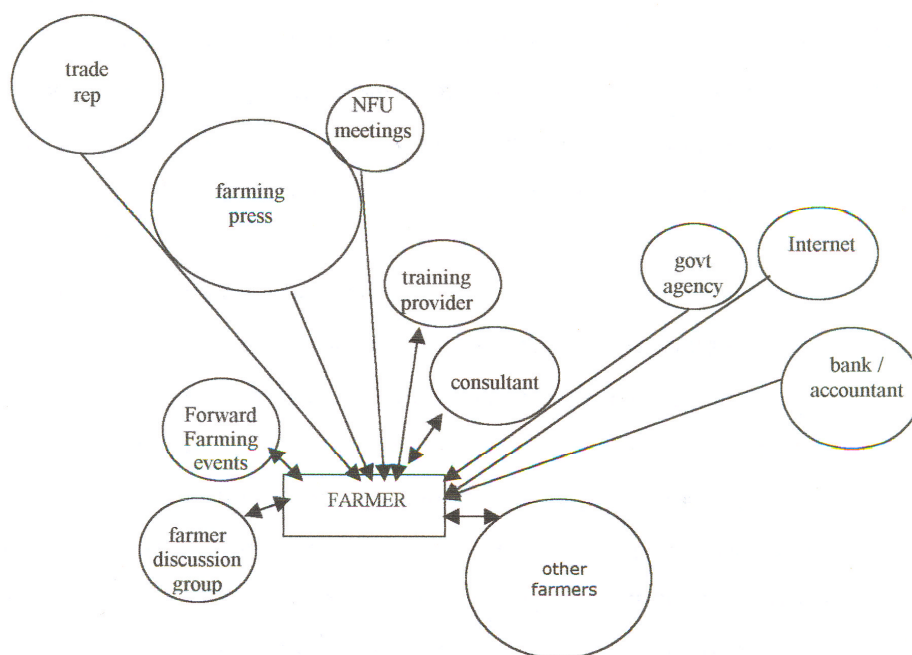
Notes: (1) Shaded cells are links where good communication and frequent interaction are essential to the successful running of a demonstration farm network on the Forward Farming model; (2) numbers indicate the evaluation team's assessment of the strength of the linkage in Forward Farming: 0= none; 1=weak; 2=moderate; 3=strong.

Information maps were also developed for attendees (Figure 2) and non-attendees using data from the telephone survey. The maps represent the value of the source of information to the farming population and the extent of interaction that takes place, the arrows indicating the direction of the flow of information. The maps were then presented to the two farmer focus groups for discussion and comment. Comparison between the two maps, confirmed by the focus group discussions, suggested that demonstration farms are a means of intensifying the interaction farmers have with other farmers, both in one-to-one interaction and in discussion groups. From this perspective demonstration farms are not substitutes for the other activities and sources from which farmers gain information and advice on technical and business improvements: however they do add a valued dimension to farmers' knowledge and information systems, in particular the opportunity to look around the farm. Non-attendees rely more heavily on the farming press and trade representatives than attendees.

Discussion and conclusion

At its simplest, the notion of 'on-farm demonstration activity' stimulates the process of learning through information provision and knowledge transfer. At a demonstration event, farmers can see particular technologies or management practices in operation on a working farm not too dissimilar to their own. If a specialist in a particular technology or management practice is

Figure 2. Information map for Forward Farming attendees.



Note: The size of the circles in the map is approximately proportional to the percentage of respondents who reported the respective source or activity as one with which they communicate or in which they participate, in the context of making decisions about changes in their farming practices. The distance from the farmer represents the extent of immediate interaction that farmers can have with the other party/ies in the activity.

present at the demonstration, the event brings together two complementary sources of information and ideas, the credible expert and the practical experience of farmers. If appropriately planned and structured the demonstration provides an environment where active learning can take place through visualisation and discussion as well as through listening. Whilst monitoring data may be available, the focus of the event is frequently based on the premise of a one off interaction. ‘Demonstration’ is essentially a one-off activity.

‘Monitor farms’ on the other hand are based on the premise of ongoing interaction with and within a defined group of farmers. They can therefore demonstrate the application of a specific technology or combination of technologies over time, which allows monitoring and comparison in a specific context. Monitor farms may not necessarily demonstrate best practice, but are farms with the potential to demonstrate improvement over time. Farmers, both the host and an associated discussion group, learn from the process and impact of change.

Under Forward Farming, Defra in effect invested in increasing the supply of demonstration activities and of opportunities for monitoring. The evaluation suggests that this did not lead to a substantial increase in the total number of farms attending demonstration type activities, as Forward Farming attendees were more likely than their non-attendee counterparts to have attended similar events on previous occasions. The evidence from the evaluation suggests that a more efficient and flexible approach would be to establish a regional capacity to allocate public funds for facilitating both the demand for and supply of demonstration and monitoring initiatives to meet national policy goals as well as take account of regional gaps in provision to meet identified needs. This is consistent with the increasing trend in the UK towards regional management of development initiatives. Part of the resources could be used to fund facilitators who would work with local groups of farmers to identify their own needs, source activities from those already available, and arrange to fill gaps in existing provision.

In addition to funding activities through regional initiatives, a number of other principles were derived from the evaluation.

First, the need for clear objectives which are relevant to all stakeholders and which can be communicated clearly is fundamental. Crucial to this is the need to recruit or select the right facilitators or co-ordinators. Further, involving stakeholders in the setting up and management of demonstration farms is important in achieving accountability to the industry and the wider public.

Second, in choosing host farms, the criteria and process will differ for one-off demonstrations, a fixed site demonstration farm, and a monitor farm. For the latter two, the process should be bottom up, with a facilitator working with the local industry to identify one of their number to be a host farm for either demonstration or monitoring or both. For one-off demonstrations, the main criterion is the appropriateness of the farm for demonstrating the particular practice or system. Further, host farmers need incentives. As in the case of Forward Farming, this will usually be some combination of money and the benefit they expect to gain from access to expertise and advice. Farmers may also need training in presentation and communication skills, as well as in the issues to be demonstrated.

Third, evidence from the comparator case studies suggests that farms should remain demonstration and/or monitor farms for a limited lifetime, possibly a maximum of five years; and within any project or scheme there should be opportunity for groups to go to other farms for one off events if they can better demonstrate a particular issue. Arranging different types of effective off-farm activities may also be beneficial.

Fourth, there is no clear indication from the pilot project, nor from the case studies, of the best option for who should host a demonstration event. There is a trade-off between the continuity of a consistent presence (host farmer or facilitator) on the one hand, and expertise (consultant) specific to the issue

being demonstrated on the other. The evaluation confirms that farmers value credible sources such as independent consultants, other farmers with experience of the issues, veterinary surgeons and other professionals. Involving them in events will add to their impact.

Fifth, for business clubs and monitoring activities the facilitator's role is even more critical, both in helping the group develop the degree of trust and commitment that is necessary before they will feel able to share and discuss financial details of their businesses and in compiling the data that are the raw material for the group's discussions. It is clear that benchmarking, in any formal sense, is not central to most farmers' perceived benefits from demonstration farms, but that ideas of generally comparing their performance with those of others are widespread and seen as beneficial.

Sixth, subject matter is a further consideration, as are event titles. In choosing issues to address on the farm, the challenge is to balance local demand and interests with the national interest implicit in a centrally funded initiative that seeks to achieve public policy goals.

Finally, the evaluation shows that appropriate promotion and marketing is vital. The target or minimum number of attendees will vary with the nature of the event. For a demonstration that aims to spread awareness of a new practice or system, a carefully planned event should be able to cater for several hundred attendees and within that, if carefully planned, smaller discussion groups can be accommodated. However for an activity for which the primary focus is discussion-based, a minimum of 10 with a target of 15-20 is the optimum. This allows for diverse opinion and interaction to take place even when group members cannot attend each and every 'event'. More than the optimum is too many: farmers get more out of smaller groups, and serial attendees will get to know each other and are a lot happier to ask 'daft' questions than in a larger, impersonal group. This facilitates interaction and participants learn more.

In conclusion, although farmers clearly value the opportunity that demonstration on a working farm offers to see and discuss possible future strategies for their own farms, increasing the supply without at the same time doing something to stimulate new demand is likely to lead to those who already take advantage of demonstration opportunities doing so more frequently. Particularly challenging is to raise demand for demonstration and monitoring activities related to improved business management: as the Forward Farming experience shows, English farmers are on the whole still more interested in how to improve technical performance. With the CAP reforms in place from 2005, however, farm subsidies are no longer linked directly to levels of commodity production but to farm area and the production of public environmental goods and services. For those in the business of providing education and advisory services to farmers, this represents both an opportunity and a challenge: demonstration of changes and strategies to respond to the new subsidy regime will certainly be needed, but so too will

action to stimulate demand through innovative promotion and local facilitation.

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REFEREED PAPER

**FARMING FUTURES: SOME IMPACTS OF THE
FISCHLER REFORMS ON LIVESTOCK FARMING IN THE
NORTH EAST OF ENGLAND ¹**

Jeremy Franks

The Fischler reforms are introduced and considered from the perspective of livestock farming in the North East of England. The dependency of livestock farming on the previous subsidy system is shown. In England the Single Farm Payment (SFP) has been “decoupled” from production: farmers will receive it providing they satisfy cross-compliance conditions. This research suggests that many farmers will, at least initially, have to use their SFP to support their farm businesses (i.e. support will in effect remain coupled). For how long they will need to do this is an open question as it principally depends on input and output market prices (which are difficult to estimate) and their commitment to farming.

(Key words: Single Farm Payment, Fischler reforms, diversification, North East, England, livestock farming).

Introduction

Even before the changes introduced under Agenda 2000 and the mid-term review (referred to here as the Fischler reforms) John McInerney (1998) gave a Massey Ferguson National Agricultural Lecture titled “Agriculture at the Crossroads”. This suggests that farming regularly faces policy changes which have crucial impacts on farm business decisions, and the Fischler reforms represents another such occasion. All prudent farmers need to re-examine previous strategic decisions, in particular, those related to,

- the development of the farm business, will some other development trajectory now be more sensible?
- if the plan is retained, should the strategy developed to get there be changed?
- if the plan is revised, what new strategy should I adopt?

This paper considers these strategic issues from the perspective of livestock farmers in the North East of England. Farming in this region is outlined and its dependency on the previous subsidy system shown. The Fischler reforms are briefly introduced and then applied to a representative North East livestock farm (based on data presented in the North East Farm Business Survey Report) to examine their financial impacts. Implications of the reforms for future development strategies are then considered.

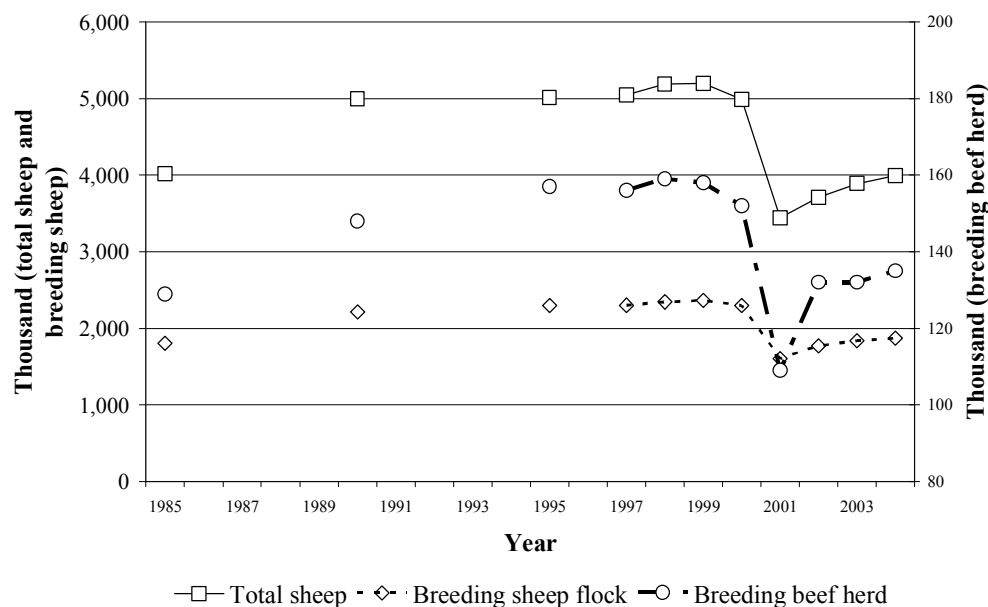
Farming in the North East

A good deal of the land in the North East is Grade 3, 4 and 5. Some better land is located close to the coast some of which is used for growing potatoes and vegetables, but most is uplands and within the moorland line (i.e. and is therefore classified as being seriously disadvantaged area (SDA) land, or

1. This paper was presented at a meeting of the North-East Branch of the University of Newcastle Alumni on Thursday 16th February 2006, at the University of Newcastle.

adjacent to it (and therefore classified as disadvantageous area land (DA)). As a consequence the most widely grown crop is grass (789,000 of a total farmed area of 1,017,000 ha). This is grazed by calves and cattle for beef (744,000 head) and for breeding (135,000 head) and sheep for lamb (2,118,000 head) and breeding (1,872,000). Figure 1 shows the change in livestock numbers in the North East. Whilst livestock numbers have recovered since foot and mouth disease in 2001, they remain at their 1985 level - indicating farmers have already destocked in anticipation of the Fischler reforms. Whilst there is a significant concentration of dairy herds in Cumbria, a region in the North-West of England, not much milk is produced in the North East (128,000 dairy cows). So the dominant farm types are cattle and sheep farms. This article therefore considers the effects of the Fisher reforms from the perspective of cattle and sheep farms in SDA and DA.

Figure 1. Livestock populations in the North East.

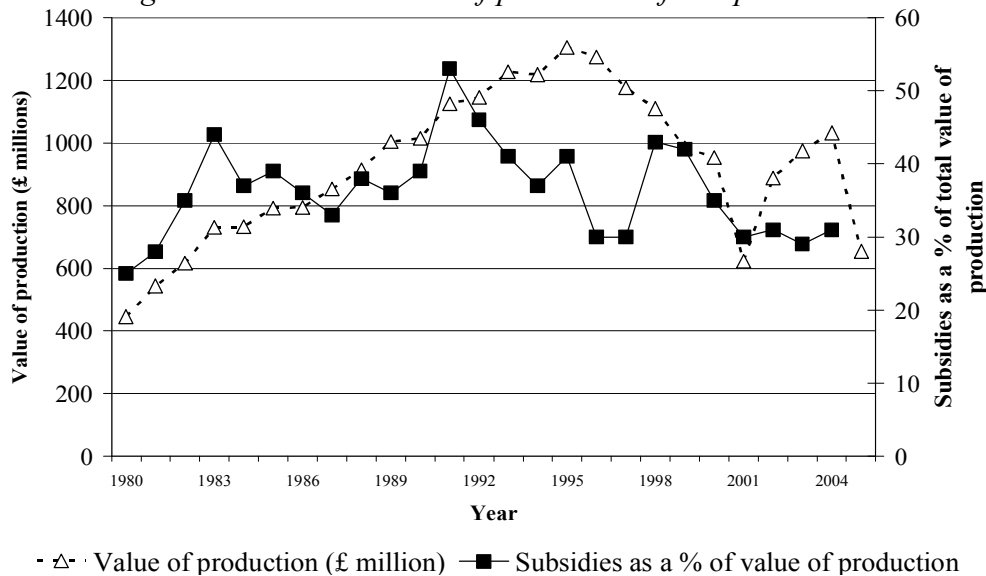


(Source: Farm business Unit (various)).

Figures 2 and 3 show revenues from the sale of sheep and lamb and from beef and calves respectively. Subsidy payments as a percent of the total value of production (i.e. including subsidies) have hovered around the 35% mark for sheep and around about 45% for beef (showing the impact of the introduction of the Over Thirty Months Scheme in 1996). Whilst top third upland herds generate a positive net margin excluding subsidies for sheep enterprises (£17/ewe) the average upland herd lost £8/ewe (EBLEX 2005c; Eblex 2005d). The top third upland suckler cow enterprises lost £46/head when subsidy payments are excluded, the average upland suckler cow enterprise lost £132/head (EBLEX 2005a; EBLEX 2005b). Figure 4 confirms the importance of subsidies to livestock farms in the North East. This shows “subsidy payments

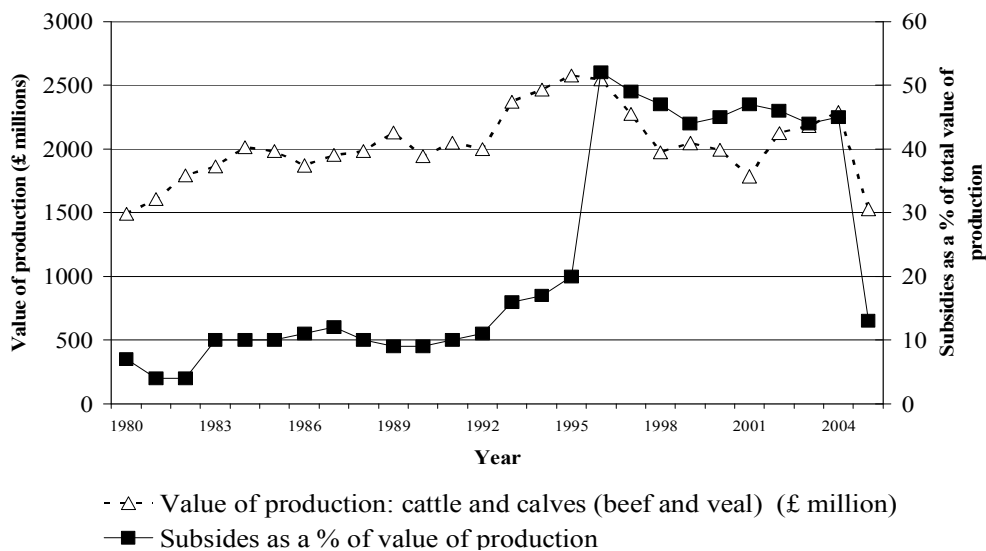
as a total percentage of the value of total farm output” are about 25% for Hill Rearing and Upland Rearing farms. This data confirms a stark reality, that livestock farming without subsidies would simply not be profitable in the hills given current market prices and cost structures, a conclusion that owners of large tracks of upland land have also arrived at (National Trust 2005).

Figure 2. Subsidies as a % of production of sheep and lambs



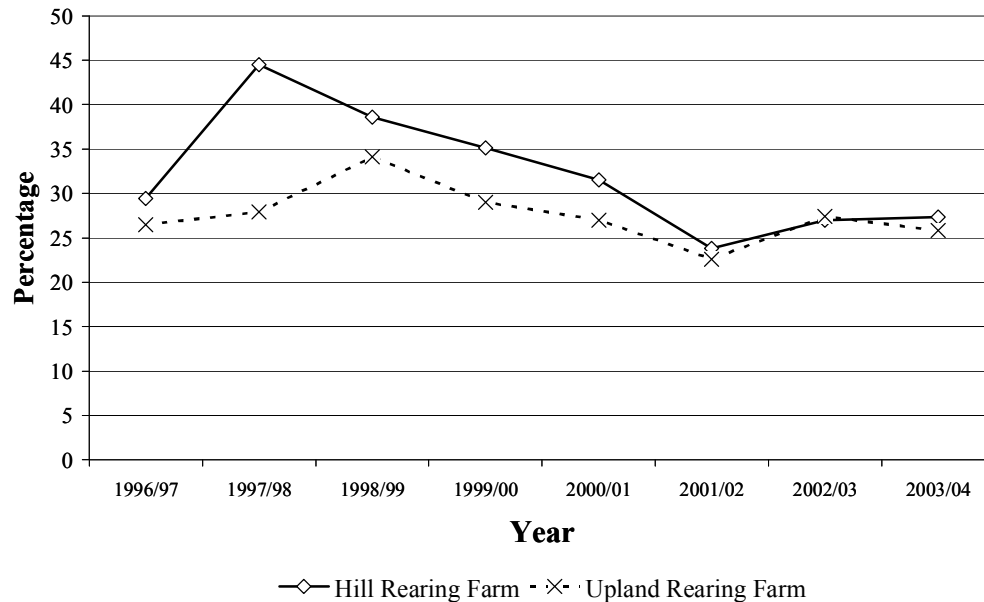
Source: DEFRA (2006a: Table 6.15. U K sheep and lambs: mutton and lamb)

Figure 3. Subsidies as % of value of production of cattle and calves, (2005 provisional figures)



(Source: Defra (2006a: Table 6.13 UK cattle and calves)).

Table 4. Subsidy payments as a % of the value of total farm output.



(Source: (Farm Business Unit various)).

The Fischler reforms

The details of the Fischler reforms, which came into operation in England on 1st January 2005 (the so-called ‘delayed regional flat rate’ or the ‘dynamic hybrid’ system) are by now well understood. Briefly, all subsidy payments (excluding Hill Farm Allowance and environmental payments) have been converted into an historic element on a farm-by-farm basis. This historic element will then to be converted in eight annual steps into a flat rate payment which reflects the farm's land category. There will be three land types; ‘non-seriously disadvantaged area’ (i.e. lowland), seriously disadvantaged area (SDA) outside the moorland line and SDA inside the moorland line:² the result it that by 2012 all farmers will receive a common, flat rate regional average payment (RAP) for each ha of similarly classified land: these rates are set at £192.30, £160.80 and £22.90 for lowland, DA and SDA land respectively.³

The Single Farm Payment (SFP) will be reduced by financial discipline⁴ and by national and EU modulation. The EU modulation rate, applied to the fraction of any payment above €5,000, will be 3% in 2005; the 2005 UK modulation rate will be lower at 2% but applied to the entire payments. Future modulation rates are not yet known but are expected to increase, and farmers should budget for a combined modulation of at least 25% by 2012 (Farmers Guardian 2004) and it may be considerably higher following agreement to

2. England SDA includes approximately 1,627,037 hectares of land of which 798,969 hectares lies within the moorland line. A map of LFA Severely Disadvantaged Areas is available at <http://www.defra.gov.uk/farm/capreform/pdf/EnglandSDA.pdf>

3. A total of 7.54 million ha of lowland, 0.84 million ha of SDA non moorland and 0.6 million ha of SDA moorland have been registered: a total registration in England of some 8.98 million ha. The flat rate has been calculated by dividing the historic payments of each region by the area of land registered in that region.

4. Financial discipline starts in 2007 and is to help balance the budget following EU enlargement.

allow national treasuries to withdraw their matched funding of Rural Development expenditure from 2007. The combined effects of these transitional payments and modulations are examined in the next section.

Of significant importance is the fact that the SFP is decoupled from production in the sense that farmers will be entitled to receive the SFP irrespective of what they produce – they can change enterprises or even produce nothing – provided they satisfy the cross-compliance conditions. Depending on one's perspective, decoupling can be regarded as a means to continue income support to the agricultural community with less or no distortions on production (Anderson F.C.A. 2004) or as a transition policy towards a more market oriented agricultural business. Farmers have received much advice on what the SFP may mean for their business. For example, the Meat and Livestock Commission (MLC) advised farmers that, "any margin from the single payment after cross-compliance and other costs should where possible not be used to subsidise annual trading costs", (Meat and Livestock Commission 2004a: 2004b), implying it may be used for capital investments (which if it is, means that the SFP is not a decoupled payment). The MLC has no survey data to indicate how farmers intend to use their SFP but believes many sheep farmers will continue for 12-18 months to see how the new payment scheme works out.

Impact of the Fischler reforms on farming in the North East

To examine the impact of the Fischler reforms the Single Payment rules are applied to a representative Hill Rearing farm of 424 hectares of which 339 ha are moorland and 85 ha upland non-moorland with historic payment of about £33,760 and a regional average payment of £21,426 (Table 1).^{5,6}

Table 1. Single Farm Payment for a representative (424 ha) Hill Rearing farm in the North East (RAP of £21,426 and historic entitlement of £33,763).

Yr	% RAP	RAP	% hist	Historic element	SFP	% modulation	SFP less modulation
2005	10	2,143	90	30,387	32,529	9	29,602
2006	15	3,214	85	28,699	31,912	14	28,402
2007	30	6,428	70	23,634	30,362	20	25,252
2008	45	9,642	55	18,570	28,211	21	22,569
2009	60	12,856	40	13,505	26,361	22	20,561
2010	75	16,069	25	8,441	24,510	23	18,873
2011	90	19,283	10	3,376	22,660	24	17,221
2012	100	21,426	0	0	21,426	25	16,069

5. Data taken from the North East based on data gathered by the Farm Business Survey.

6. Key assumptions are the percentage of land within each RAP land tier (*per. com.* Charles Scott, Director FBU Newcastle) and the rate of modulation in future years.

Figure 5 shows each annual SFP up to 2012 when support payments have fallen by £17,694. Figure 6 shows the annual shortfall in support as a percentage increase in market revenue needed to replace the lost support (this is based on the strong assumption that all costs remain unchanged and no other income sources are developed).

Figure 5. Annual SFP received by a representative North East Hill Rearing farm.

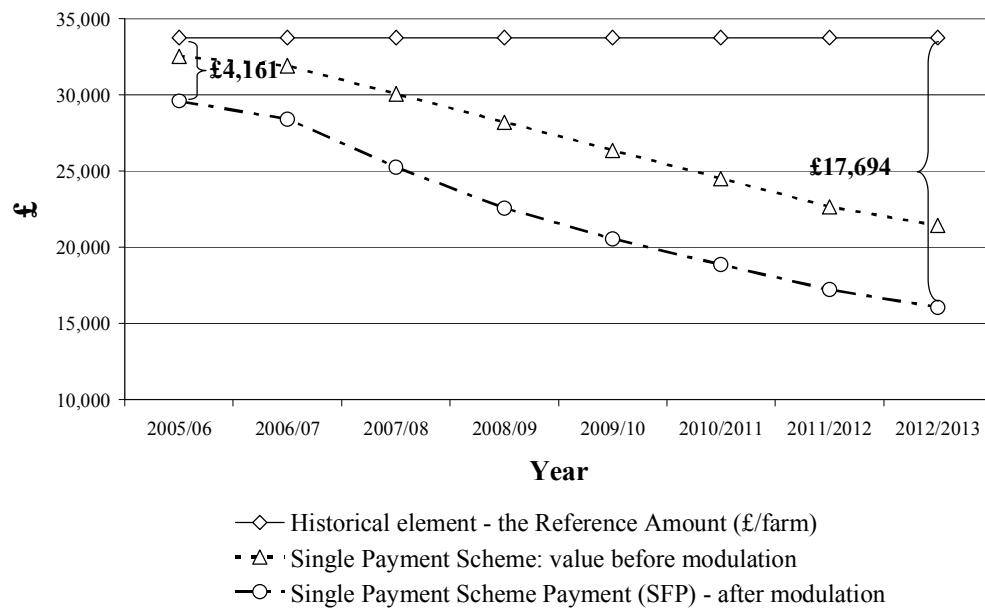
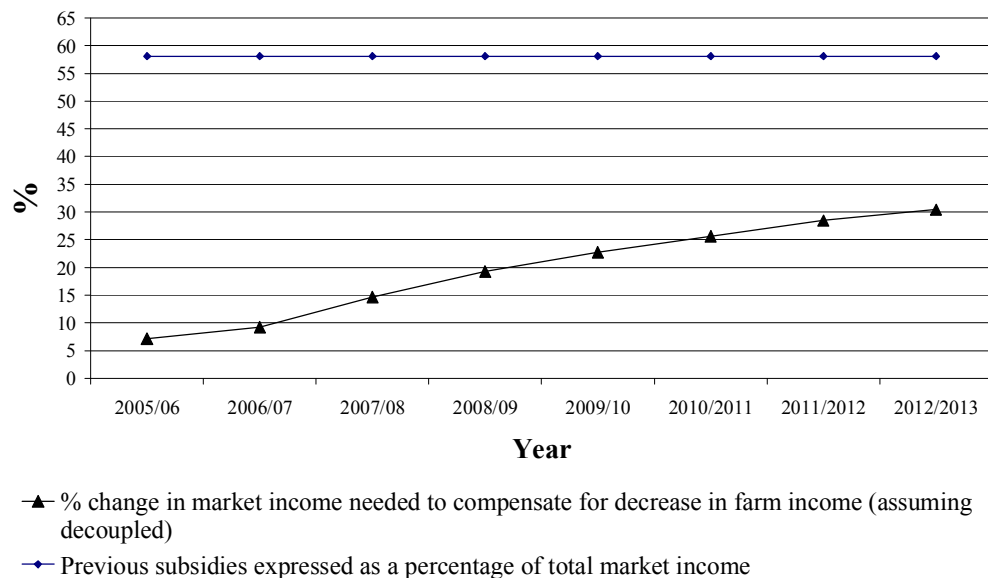


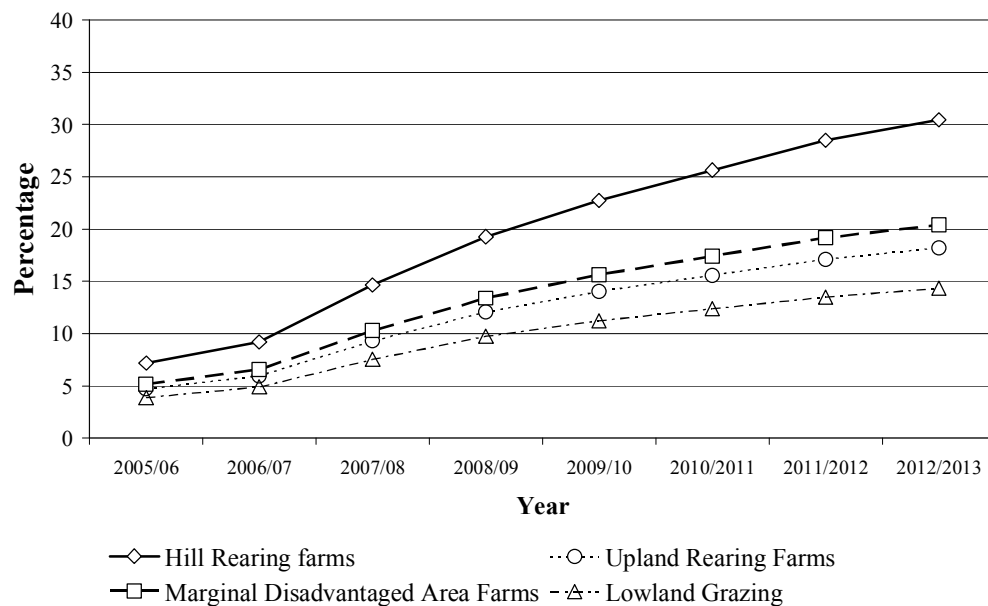
Figure 6. Percentage change in market income needed to replace loss of historic payment: treating the SFP as coupled and decoupled (Hill rearing farm).



If the farmer treats the SFP as coupled then in 2005/6 market income needs to rise by about 8% to make up the shortfall in revenue. This is within the ranges of what may be considered possible and adopting this strategy buys the farmer time. As the historic weighting reduces the shortfall increases, and therefore the percentage change in market revenue needed to make good the support shortfall increases. By 2012/13 market prices need to increase by 30% to generate the same total farm revenue. Note that this action disregards the advice of the MLC presented above but as Figure 6 shows, if farmers do not couple the SFP they need a 58% increase in market derived revenue to replace the previous subsidies, and changes of this magnitude were most unlikely to occur (and indeed so far have not). Figure 7 shows the annual percentage shortfall in total farm revenues for each year for other farm types assuming farmers treat the SFP as coupled.

The conclusion is clear; farmers cannot expect to make up the reduced support from increases in market returns of this order of magnitude whereas market derived revenue may make up the shortfall if SFP are treated as coupled. The data reinforces the stark reality that unsupported incomes from livestock farms will simply not be sufficient to return hill farmers to previous levels of farm income. When, and by how much costs fall and market prices increase are therefore key questions.

Figure 7. Percentage change in market income needed to replace subsidies (assume SFP is coupled): by farm type.



Reduction in costs

Currently, English upland and lowland beef production costs are around about 300p/kg dwt, with a market value of 180p/kg dwt. To compete, UK farmers need to lower their production costs to somewhere like 120p/kg dwt given the stiff competition that is already coming from Brazil where farmers can profitably sell beef for 47p/kg lwt (about 90p/kg dwt (Farmers Guardian 2005a)). Even after current import tariffs, Brazilian beef is imported into the EU, and these protection levels are likely to fall should a WTO proposal to removal all export subsidies be accepted - a suggestion to which the EU was ready to agree to.

This implies farmers must reduce their costs by at least 180 p/kg dwt, which Robert Foster, Chief Executive of the National Beef Association, says will be impossible (Foster 2004: p. 55). In his view market prices will need to increase from about 180p/kg dwt to 250p/kg dwt (about 70 p/kg dwt), implying costs can be reduced by between 60-80 p/kg dwt. Consequently, Foster believes farmers need to “use their SFP as a capital fund to finance the cost saving changes they urgently need to make. And they should introduce these as quickly as they can because they will never have more SFP at their disposal than they will this year or next” (National Beef Association 2005: p.7): advice to farmers that they should be prepared to couple their SFP to their business.

Farmers are likely to benefit from a reduction in the price of some inputs. For example, quota leasing and purchase costs disappear with the ending of the headage payment scheme. There has been some reduction in land rentals in the North East as farms no longer need to pay high prices to lower whole-farm stocking rates below the required level. As farmers no longer need to keep animals on their farm simply to claim payments beef animals will be sold younger than they are at present⁷ (the average age of slaughtering fat steer cattle increased to over 24 months when the second Beef Premium Payment Scheme was introduced (Meat and Livestock Commission 2001) and retention periods disappear. Moreover the replacement of the Over Thirty Months Scheme with a BSE testing scheme should result in higher prices for culled animals which may reduce herd replacement costs by between £25 and £40/cow (Foster 2005). What the combined impact of these lower costs might be has not been studied, but is clearly an important area for further research.

Output market prices

Studies have shown how difficult is to estimate the impact of the Fischler reforms on market prices (DEFRA 2004b). For example Moss *et al.* (2002) estimated that by 2010 UK beef and sheepmeat production might fall by 11% and 12%, and that production falls of these magnitudes will result in market price rises for beef and sheep of 16% and 23% respectively. Research by Harper Adams University College and the Scottish Agricultural College (Harper Adams University College and S A C 2002) suggested a 10% reduction in UK beef production but a market price increase of only 4%

7. There will be no need to keep them until they are 24 months old to claim the second headage subsidy

(compared to 16%), and a 3% (rather than a 12%) reduction in sheepmeat production, with only a 'small price' increase (compared to a 23% increase). When their results were aggregated to the national level, the decline in beef production was estimated to be about 57%, and in sheepmeat production 11%. When the price rises estimated by Moss *et al.* were applied to these second estimates, there was no change in sheepmeat production but a 39% rather than 57% change in beef production.

The range of values makes these outcomes difficult to understand and, from a farm manager's perspective, appears only to confirm the uncertainties involved with the reforms: these model estimates are of little value to the working farm manager. Besides, changes such as the reopening of the export of live animals – which has already put a firmer price into the market - and likely but subtle adjustments to fixed costs (Jones 2005) simply cannot be incorporated into such models.

However, it is clear that Defra expects farmers to invest a proportion of the SFP in ways that add value to their produce; "It was absolutely wrong to suggest that CAP reform will cause a collapse in hill farming. The SFP and environmental stewardship will enable farmers to connect directly with consumers and put their businesses on a more sustainable footing." (Farmers Guardian 2005b: p. 4). In using their SFP to improve marketing systems, farmers are again being advised to couple these payments with their farm business.

Future strategies for UK farmers

Despite the uncertainties over changes to costs and market prices, a prudent farmer would be advised to expect total revenue to fall following the Fischler reforms. However, quantifying that fall is difficult. For many farmers, assessing the proportion of the SFP to use to support annual shortfalls in revenue and the number of years they are prepared to do so are key strategic decisions, for this analysis suggests that the majority of livestock farmers in the North East will have little option but to act in this way. However, the SFP does provide an opportunity to rebalance the farm business by, for example, reducing debts, developing value adding and/or reducing costs. Some possible strategies are reviewed below.

Marketing: branding production

Farmers will need to become better at marketing their products if they are to compete with imported meat, so they need to find ways to convince UK consumers to pay more for beef of UK origin. However, there is some evidence that UK consumers will respond to well-focused marketing initiatives. English Beef and Lamb Executive (EBLEX) asked consumers which areas of the world they would be willing to buy beef from (EBLEX 2005e). Beef from Scotland, Wales, Ireland and the North of England were placed in the "desirable" category, beef from Africa, Asia and Russia fell into the "uncomfortable" category, and beef from Brazil into the "unacceptable" category. Point of origin labelling, that stress quality, assurance and provenance is therefore likely to benefit UK beef farmers. The EBLEX study

revealed consumer perceptions of the North East. Consumers have positive imagery about the region, with its strong connections between rural and urban areas. Food and agriculture are considered to be a source of pride and consumers found it easy to imagine beef and lamb coming from this area. People of the North East view themselves as passionate and prone to extremes (reflecting the rugged and wild countryside in Cumbria and Northumbria). But, consumers complained of a shortage of locally produced and branded meat products.

There is clearly a market for beef from the North East. Marketed to capture the local wildness and ruggedness of the area, labelled to appeal to this imagery and directed at local and national markets, red meat initiatives have an opportunity to build upon existing consumer support to further stress these increasingly important consumer purchasing criteria.

Environmental payments

The Environmental Stewardship Scheme offers farmers easier access to environmental based support through its entry level tier than was available through the Environmental Sensitive Area or Countryside Stewardship Scheme. Many farmers have already linked their sustainable production system to marketing initiatives, and a Defra commissioned study into possible changes to the Hill Farm Allowance support scheme, has considered one option that would hand over the £27 million payment into the agri-environment scheme budget. Another option considered was to link this sum to farmers who have part or whole of their holding enrolled into some (new or old) agri-environment scheme (Cumulus Consultants Ltd 2005) further reasons for taking the Environmental Stewardship scheme seriously.

Diversification and off-farm working

In 2003 income from diversification activities topped £100 million for the first time: 800 farms had annual turnover of more than £50,000 from diversified activities, 3,600 farms had turnover of between £20,000 and £50,000 (DEFRA 2004c). Table 2 shows the proportion of full-time farmers with diversified enterprises and off-farm employment in England and the North East and Yorkshire (DEFRA 2005). The percentage with diversified enterprises in England is 46, 12 points higher than in the North East and York. Table 3 shows the types of diversified enterprises in England and the North East and Yorkshire (DEFRA 2005). Farms in both regions engage in similar types of diversification, it is simply that farmers of the North East and Yorkshire have fewer of them.

However, the percentage of spouses with off-farm employment is around about 30% in both regions (Table 2). The percentage of farms with neither diversified enterprises nor off-farm employment is 37% across England but 47% in the North East and York. The 10 points difference suggests farmers in the North East and York need to re-examine their attitudes to working off-farm and establishing diversified activities. Where these percentages are low because of weak local rural and regional economies, (the problem of the low

opportunity cost for hill farmers for example) there is less an individual farmer can do to improve matters working alone. Farmers need to collectively put their case for regional assistance to Regional Development Agencies. One example of where this has happened in Cumbria is a group of 14 farmers have joined together to advertise and to sell holiday accommodation under the title “Luxury in a Farm” (Cumbrian RDA).

Table 2. Proportion of full-time farms with diversified off-farm activities

	England	North East and Yorkshire
Total number of farms (> 8ESU)	60,800	8,900
% wit diversified enterprise (excluding agricultural contracting)	46%	34%
Farmer/spouse have off-farm employment or self-employment	30%	30%
% have neither	37%	47%

(Source (DEFRA 2005: Table 8)).

Table 3. Type of diversified activity in England and the North East and Yorkshire

	England	North East and Yorkshire
Total number of farms (> 8ESU)	60,800	8,900
Number with diversified enterprise (excluding agricultural contracting)	27,800	3,000
Of which:		
Renting buildings	78%	74%
Processing and retailing of farm produce	15%	14%
Tourists accommodation and catering	15%	15%
Sport and recreation	9%	8%
Other	8%	5%

(Source: DEFRA 2005: Table 9)).

Working together

Marketing, using all of a farm's resources, reducing costs and generating additional market income are all strategies farmers might adopt as they adapt to the reforms. It is also quite clear that farmers are increasingly going to have to look beyond the farm gate to earn their farm living. Many farmers already work together to lower their production costs (EFFP 2005); some have also joined together in marketing initiatives (EFFP 2005). There are many other benefits of working together, as demonstrated by the “Luxury in a Farm” initiative referred to above.

There may also be benefits in working together in addressing the requirements imposed by the Water Framework Directive (WFD), which aims to reduce diffuse pollution which costs £211 million a year to clear-up. (H M Treasury 2005: p. 5)⁸ Current policy has identified voluntary action based on win win solutions as a key instrument for implementing the catchment scale changes in farming behaviour needed under the WFD (Environment Agency 2005). The fact that the Environmental Regulators have signalled a willingness to use voluntary instruments based on win win solutions indicates farmers’ strong negotiating position (Börkey and Lévêque 2002). Co-operation may

allow farmers to deliver environmental benefits at lower cost to themselves, help secure the delivery of their side of the win win deal, and may also help to avoid statutory regulations (Franks and McGloin 2006).

Working together can also influence policy. In particular, to argue for changes to planning regulation to secure payments through the Hill Farm Allowance and maybe money through the Leader program to support community based actions that could be used, for example, to organise community management of the wild areas created by the withdrawal of farming from them (Midmore and Moore-Colyer 2005).

Discussion

Although designed as a decoupled payment, this analysis shows that many in the industry expect farmers to use their SFP in place of it to lower production costs, add value to produce and/or to develop diversified enterprises; each of these responses effectively treat the SFP as coupled. A fully decoupled payment would be invested away from farming, with the farmer supplementing household income through part-time employment, a step that often represents their first move to exit from farming. To help those wishing to quit farming, capital markets are being developed to convert these future income streams represented by the SFP into a capital sum which farmers can be paid now (Farmers Guardian 2006: p.107).

Whether the SFP is decoupled relies on a combination of behavioural and technical issues. Behaviourally, it depends on how individual farmers chose to use the SFP. However, although farmers receive the SFP irrespective of what they produce, Swinbank (2005) has questioned whether the SFP is technically decoupled. He argues that because its size depends on the ‘factors of production employed in farming’ (i.e. the area of farmland) it is coupled, and so might fall outside the “green box”. It is a payment that is only available to farmers and in that sense certainly remains coupled to farming. These issues make it likely that further CAP reform will remain high on the political agenda.

However, the previous headage payments increased farm profits and some of this additional profit was paid to lease quota (as holding quota was a necessary requirement to access the subsidies). Some farmers purchased rather than leased quota. The removal of the headage payments removes the quota leasing cost but also wipes-out quota value from the balance sheet of quota owners. This change therefore benefits quota leasees more than quota lessors or quota owners, particularly if quota owners had borrowed to finance a recent quota purchase. For those who purchased quota, some proportion of the SFP can be seen as compensation for the loss of that investment. Investing this proportion into farming simply replaces the lost asset value leaving the farm asset neutral (for example by repaying any outstanding loan). Under these circumstances, there is a clear argument and justification for treating the SFP as coupled and investing an equal value of the SFP in the farm business – but this is still not an argument for using the SFP to subsidise shortfalls in annual household income.

Farmers who have used the SFP to support annual income must decide

8. A cost ultimately borne by consumers in their water bills.

how long they are willing to subsidise their farming activities in this way. There is evidence presented here that many farmers have no option other than do this over the short-term. However, they need to find ways of investing their SFP in lowering costs or increasing output value as a matter of urgency: continuing to use the SFP this way is unsustainable. But much depends on changes to input and output market prices, which are difficult to identify not least because they are influenced by the production decisions of other farmers.

When faced with not knowing what to do, an old adage advises to “do a little bit of everything”. Many farmers have already lowered stocking rates by culling/selling their more expensive, less productive stock. Lowering stocking rates allows farming to become more extensive using less labour. Hired labour will be the first to be released. Many will have joined the entry level tier of the Environmental Stewardship Scheme and be considering diversification and off-farm employment opportunities. Farmers considering quitting are likely to sell or lease their farmland to others wishing to expand to lower costs by capturing production and marketing economies of scale. This allows them to invest their SFP in alternative business ventures whilst continuing to be registered as farmers and earning some income from renting-out their farmland. One problem in the North East appears to be a lack of alternative employment in as far as the low percentage of farmers and spouses working off-farm is caused by a weak local/regional economy.

The preceding analysis is based on representative farms. Whilst subsidy payments are ring-fenced within each land area, there will be a transfer of subsidy from ‘more intensive to less intensive producers within each land area, and to land used for enterprises in 2005 that were not in receipt of direct area subsidy or land used for livestock which had not received headage payments (such as potatoes, sugar beet, field vegetables, outdoor pigs etc)’ (DEFRA 2004a: p.2). This aspect of the Fischler reforms has not been examined in this analysis.

In 1998 McNerney wrote “agriculture promises to evolve over coming decades to something very different to the traditional primary industry it has been until now” (1998: p. 22). The analysis and data presented here shows the process of evolution has been occurring and it is likely that the SFP will increase the rate of evolution and structural change within agriculture. The forces driving these changes are very powerful and very real and bring in their wake the need to manage change: that most difficult of all management activities. Whilst it is also clear that these managerial requirements have not been helped by the delays and uncertainties surrounding the introduction of the Single Payment System (DEFRA 2006b). Bearing the cost of bureaucratic failure has long been a price the sector has had to pay for its dependency on subsidies, and hopefully the new SPS, once bedded in, will release farming from this. This may be an important possible long-term net gain of the Fischler reforms.

Conclusion

The Fischler reforms are more dramatic and far reaching than anything that has come before. An analogy with Spaghetti Junction rather than the McNerney crossroad is more appropriate as farmers re-examine their strategic

plans. The Spaghetti Junction logo illustrates the wide number of choices open to farmers whilst at the same time conveying the confusion generated by these choices. Farmers have been faced with a turning point in their business, those who make a commitment to be in farming in 10 to 15 years time need to plot a route to deliver that outcome. There will still be a demand for UK produced food but it is likely that fewer farmers will be supplying that market. However, it is unlikely that the number of registered farm businesses will fall much, as people like to live in the countryside and enjoy the standard of living (and tax benefits) being self-employed farmers offers them; most farm businesses will simply get smaller with more farmers becoming part-time farmers. For this to happen, those who have lived their whole lives in rural areas and newcomers alike need to develop innovative income streams to develop and maintain their rural economy and infrastructure.

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Biographical notes

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VIEWPOINT

**FROM MAFF TO DEFRA – A POLICY CHANGING
JOURNEY FOR AGRICULTURE**

Neil Carmichael

The history of the government department for agriculture is also a description of changing policy priorities for food production and countryside management. The creation of DEFRA signalled a departure from farmer focused delivery with two dominating issues: first, the impact of 'policy filtration' and, second, the environment. The paper will trace the changes in structure, assess the impact of "mergers" and analyse DEFRA's influence within the cabinet. The conclusion is that DEFRA represents a fundamental change in making and delivering rural policy.

Keywords; Department, accountability, structure, policy, filtration, history

From the Board of Agriculture to DEFRA

This paper expresses my view of the emerging structure and priorities of the government department for agriculture and rural affairs using a 'descriptive-inductive' methodological approach to political science. By examining the events that led to the creation of the Department of Environment, Food and Rural Affairs (DEFRA), it explains "contemporary political phenomena with reference to past events" (MARSH and STOKER, 1995, p44).

The Ministry of Agriculture, Fisheries and Food (MAFF) started life as the Board of Agriculture following an Act of Parliament in 1889. It celebrated its centenary in 1989 but almost immediately afterwards the shape and scope of the department became a matter of debate. This was partly because MAFF was one of the few departments to escape the rash of mergers creating "super-departments" during the 1960s and 1970s, and, by 1981, was the only remaining department to be headed by a mere 'Minister' rather than a Secretary of State. In fact, MAFF had been the virtual forerunner of ministry mergers in 1955 when the previous Ministry of Agriculture and Fisheries, as anticipated by Winston Churchill's 'Overlords' in 1951-52, joined forces with the Ministry of Food under the future Chancellor of the Exchequer, Derek Heathcoat Amory (Foreman 1989, p 127). This development, however, was not of the same order as later mergers.

By 1975, most ministries had been absorbed or merged. For instance, 1970 saw the creation of the Department of the Environment (DoE) from the old Ministry of Housing and Local Government, Ministry of Transport, and Ministry of Public Buildings and Works. At the same time the Department of Trade and Industry (DTI) was launched to cover trade, technology, power and industry through sweeping away the already large Ministry of Technology and the longstanding Board of Trade. Neither of these two super-departments was left alone for long without further tinkering and revision but a mould for larger departments had been forged and would be used again although with varying degrees of success.

Until the late 1980s, MAFF escaped the attentions of reform minded Prime Ministers largely because it was delivering desired results. Remarkably, Peter Hennessy commented “[MAFF] shows that if you are a government department, you cannot win. It has presided for forty years over the most consistent and conspicuous success story in British industry and yet it is surrounded by carping and controversy” (Hennessy 1989, p 443).

The frenetic merging activity elsewhere had the effect of leaving MAFF behind. No Minister of Agriculture, Fisheries and Food has ever become Prime Minister and very few were able to use the post as a launching pad to higher office. Most often, the serving Minister has been near the very bottom of the cabinet pecking order with the clear exception being Dr. Jack Cunningham at eighth position in Tony Blair’s first cabinet. As Peter Walker observed in 1979 following his own appointment as Minister, “After two important posts as Secretary of State, this was comparatively small beer” (Walker 1991, p 145).

Changing agendas

Two policy areas conspired to transform and, eventually, threaten MAFF. Firstly, in 1973, entry into the European Union (EU) propelled the Ministry into a pivotal position through the implementation of the Common Agricultural Policy. At first, CAP emphasis on production and self-sufficiency was, essentially, an extension of the 1947 Agriculture Act and therefore entirely consistent with the ‘looking after farmers’ rationale. By the late 1980s, however, production levels of most commodities were over 80% self-sufficiency creating unpopular beef, barley and butter mountains. As John MacGregor, Minister in 1987, explained “[...this obliged MAFF] to look at the rural economy as a whole” (Hennessy 1989, p 444).

As set-aside was taken up by farmers, livestock quotas applied and further measures to encourage diversification such as ALURE (Alternative Land Use and Rural Economy) (Robinson 1990, p161), MAFF found itself fighting turf wars with the Department of the Environment which, in turn, was actively developing rural policies through its Minister of the Environment and Countryside. MAFF also became closer to the DTI as sponsor of small businesses (Hennessy 1989, p 444). The second policy area to threaten MAFF was animal welfare. Two major outbreaks of disease – one leading to “Mad Cow Disease” and the other being Foot and Mouth – further undermined the reputation of the Ministry as it struggled to reconcile its role as champion of agriculture and responsibilities for food. Twelve years after the centenary celebration, considerable controversy and increasing ambiguity over its role, MAFF finally merged with parts of the old Department of the Environment to create DEFRA.

New departments – culture, process and priorities

Methodology

The study of institutions is a key tool in political science. As Gillian Shepard remarked, on becoming Secretary of State for Education and

Employment in 1995, “I know structure does not mean policy, but a lack of structure can inhibit policy” (Aldrich *et al.* 2000, p 4); this sentiment underpins the concepts of organisational theory, behavioural and relationship analysis, and the study of public administration as deployed in this section (Marsh and Stoker 1995, pp 42-57).

Super-departments

Five characteristics of super-departments need to be examined before DEFRA’s prospects can be assessed. They are

- ‘overload’,
- policy filtration,
- culture,
- ministerial reputation and
- relationships with other departments.

As observed above, super-departments have not been immune from further adjustment, often because of perceived or actual overload. Sir Christopher Forster while advising Tony Crosland, Labour’s first Secretary of State for the Environment, 1974 -76, saw, at first hand, how the DoE initially struggled with a range of policy issues including land taxation, transport, sale of council houses (abandoned) and local government finance (Forster 2000, p 80-81). This resulted in the creation of a separate Department of Transport in September 1976 where the new Secretary of State, William Rodgers, ironically commented “[But] the prospect of running a small department did not feel like a difficult challenge” (Rodgers 2000, p159). Transport has been the victim of many changes since 1976 and has also suffered from rapid ministerial turnover up until 2001.

For the purposes of this article, policy filtration is defined as the impact of multi-level governance or agencies adapting or adjusting the outcomes of policies through delivery. The potential of policy filtration is illustrated by the recent introduction of variants of the Single Farm Payment (SFP) by DEFRA and the devolved administrations but it can also arise through structures such as the Rural Payments Agency (RPA) in consequence of the arms length relationship with Ministers. As the Select Committee for Environment, Food and Rural Affairs reported, “[Further], we believe that both DEFRA and the RPA should have anticipated the extra work involved in this project, had they taken into account the policy effects of the SFP which, by definition, increased the volume of eligible land over and above the amount covered by IACS” (Fifth Report 2006, Interim findings, paragraph 6).

The different cultures found in administration and systems can either unite or divide. When Peter Walker became Britain’s first Secretary of State for the Environment in 1970, he realised that his new department needed a culture and he seized on the environment (Jordan 2002, p 28). His autobiography makes frequent reference to pollution control measures (Walker 1991, chapter 7). Conversely, the creation of the Department for Education and Employment in 1995 was marred by the different cultures of the previously separate

departments. While Education was a 'policy and supervisory' department, often likened to an Oxford College, Employment was a much larger department, directly responsible for delivering a service (Aldrich *et al.* 2002, pp12-13).

For DEFRA, the recent past of its component parts suggested a lack of natural affinities. MAFF fully embraced Europe while the DoE had little contact and experience with the EU until John Gummer's period as Secretary of State, 1993-1997. MAFF defended its 'blanket exemption for all land-use planning legislation', first secured in the 1940s, for as long as possible and against the DoE's preference. Most Secretaries of State for the Environment have concentrated on issues other than protection of the environment largely because political action was deemed necessary for more pressing priorities, including transport for Tony Crosland, inner-cities for Peter Walker, Peter Shore and Michael Heseltine, land local government finance for Kenneth Baker, Nicholas Ridley and Heseltine: none of these policy areas are now part of DEFRA (Jordan 2002, p 177 and p 28).

Ministerial Reputation

Cabinet battles over spending, allocation of Parliamentary time for legislation and impact on government policy all rest on the Minister's political capital and ability to argue the department's case. It also matters in Brussels where long serving ministers with relevant expertise are contrasted with 'revolving door' appointments (Hoggart *et al.* 1995, p 123). The first Secretary of State for Environment, Food and Rural Affairs, Margaret Beckett, had considerable ministerial experience, having served in James Callaghan's government at the most junior level of Parliamentary Under-Secretary of State, and was ranked as the sixth most senior cabinet minister. The new Secretary of State, David Miliband, is regarded as a "rising star". This contrasts with the lowly position in cabinet often occupied by the Minister of Agriculture. It is also notable that the ministerial reshuffle in May 2006 upgraded the minister responsible for food and agriculture to Minister of State in the form of renowned Lord Rooker (DEFRA website).

DEFRA and tomorrow's challenges

DEFRA has established itself as a significant department, managing, in part, to overcome considerable obstacles which have disturbed or distracted similar rearrangements in the recent past but there remain problems including management deficiencies in delivering the SFP, expenditure levels, capacity to promote British agriculture and some internal culture differences. It has survived the demise of the ODPM, avoiding any consequential changes through re-allocation of responsibilities.

New emerging priorities

The reform of the CAP, moving from 'production of commodities' to the 'protection of the environment' and underpinned by the continued pressure on the EU budget for agriculture, is a key driver for change in or to DEFRA. The

original function of MAFF for farmers has almost changed beyond recognition and, instead, the predominance of countryside issues, rural affairs, sustainable development and related activities have been in the ascendancy in terms of political emphasis and delivery.

For the future of DEFRA and the new Department of Communities and Local Government, a fundamental question is should there be more emphasis on a division between urban and rural or between functions. Urban versus rural is an obvious debate but one where boundaries and definitions would be continuously challenged.

The Prime Minister, in his letter to David Miliband following his appointment as Secretary of State, highlighted the need to “ensure a thriving British farming sector which makes a positive contribution to the UK economy and countryside.....” but, unsurprisingly, the first priority for the new minister is climate with the specific idea of creating an “Office for Climate Change”, intended to be a ‘shared resource’ for key government departments.

DEFRA does represent a fundamental change in making and delivering rural policy. A number of factors demonstrate this, including increasing reliance on agencies, the impact of multi-level governance, and the new culture emerging from the mix of previous traditions within the old MAFF and Department of the Environment. For agriculture, this may allow for the crowding out of farmers’ interests and continued reform of the CAP with increasing focus on rural community development.

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Biographical Notes

Neil Carmichael is a public policy adviser/consultant and has an extensive background in agriculture, having farmed for 17 years. He has been a visiting lecturer, teaching a range of subjects in politics, including rural economic development. Neil is currently focussing on healthcare, regeneration in Poland and aspects of education policy. He has stood twice for Parliament and frequently contributes to policy debates within the Conservative Party and beyond.

VIEWPOINT

WHAT KIND OF AGRICULTURAL POLICY DO WE NEED IN A TWENTY FIRST CENTURY EUROPE?

Carl Atkin

This paper examines the recent DEFRA/HM Treasury publication "Vision for the Common Agricultural Policy" and argues it offers no real "vision" at all as to the future of policy in Europe, or indeed how industry and policy makers should get to an 'deal' policy framework.

Introduction

The reasons for the historic intervention of Governments in agricultural markets is well documented and widely understood. Left to themselves, in the absence of government intervention, markets for agricultural products will produce:

- Fluctuating prices, and as a result, fluctuating incomes for producers;
- Gradually declining prices, in terms of purchasing power, and as a result, declining real incomes for producers in the long run. (Brassley, 1995)

Current European agricultural policy has evolved from the protectionist support regimes created by the Common Agricultural Policy (CAP) in the early 1960s through a variety of reforms including Mansholt (1968), MacSharry (1992), Agenda 2000 (1999) and Fischler (2003), the latter bringing to bear on the industry the current decoupled support environment of the Single Payment Scheme (SPS) under the so-called "Luxembourg Agreement" of 2003.

The CAP has always been somewhat of an oddity in European policy circles. Firstly, it is the only policy which is currently 100% Brussels funded (Harvey, 2006a). Secondly, although it has five objectives as laid down in Article 39 of the Treaty of Rome (increasing productivity, ensuring a fair living for farmers, market stabilisation, food security and the provision of reasonably priced food) – the single objective of the desire to protect rural living standards has tended to dominate the implementation of the policy (Ritson, 1997).

The UK has long been an advocate of more radical CAP reform, frustrated by the unwillingness of our European neighbours to embrace change. Many previous CAP Reforms have been "reactionary", brought about by the need for budgetary control (e.g. MacSharry, 1992), enlargement (e.g. Agenda 2000) or compliance with GATT/WTO (see, for example, Harvey, 1994 and Harvey, 1997) and have been often described as 'timid' by academics and commentators (see, for example, Swinbank, 1999).

The "Vision"

In December 2005, in order to avoid such short-termism and promote a medium term discussion, the UK Department of Environment, Food and Rural

Affairs (DEFRA) published their "Vision for the Common Agricultural Policy" (DEFRA, 2005) jointly with HM Treasury. This Vision marks a useful contribution to the debate about the future of the CAP, and agricultural and rural development policy in general. However it is naïve in a number of the assumptions and sweeping statements it makes.

Firstly, it produces a long summary about the widely documented failings of the CAP to date. Whilst academically interesting, this is completely irrelevant and paints a distorted view of the current (and indeed future) policy environment. It is widely documented that the creation of the CAP in the early 1960s led to the creation of a "monster" which, forty years later, we are still trying to bring under control. Few in the agricultural industry would argue with this. Few would defend the CAP of the 1980s which led to the mountains and lakes of intervention produce or indeed the CAP of the 1990s which capitalised large production linked headage and area payments in production systems, distorting land and input markets.

But the CAP of 2006 is very different. The decoupled single payment is the most radical reform to agricultural support for several generations, yet the Vision makes little or no reference to this. Extrapolating historic data about the distorting effects of the old CAP and extending this to the new regime is highly misleading.

But what of the essential component of the 'Vision' – effectively this is the Elimination of Pillar 1 support. This may be a 'Vision' to some but to others it would be a disaster or even a nightmare (Harvey, 2006b). Again, it is doubtful that many in the industry would claim the **current** Pillar 1 support is either 'good' or 'efficient' since the single payment has evolved out of a complex mixture of market instruments and direct payments and is trying to be an 'income support', a 'compensation payment' and a 'land management' payment all in one. It is a blunt and non-targeted policy instrument which, in trying to achieve a lot of things at once, will achieve none very well, if at all. However, how this 'elimination' (if indeed this is the right thing) is managed needs much more careful thought than is offered by the Vision.

But what do we want from our agriculture, and thus our policy?

Yes, it is far better to re-focus support on what is wanted. But does Government know what "we" really want from our agriculture (the multiple stakeholders being consumers, producers, land managers, land users to name but a few). Surely "we" need to engage in a serious debate about the future of "agriculture" in its broadest sense before there can be any hope of a "Vision" for the policy. If food security is a strategic issue, then let's have a specific policy on it. If keeping small, inefficient family farms in business (particularly in Southern and Eastern Europe) is deemed a 'socially good' thing to do, then have a specific policy to do so. If paying for environmental and public goods which the market will not provide for is what society wants, then let's pay for them in a proper way through a **real** Pillar 2 rather than relying on the current Pillar 2 as an 'afterthought bolt on' to Pillar 1. But let's not pretend the vagaries of the current support system are achieving (or will achieve) any of these objectives in a targeted, effective or efficient way.

The structure and mentality of the current agricultural industry is entirely a

result of the policy instruments of the last fifty years. Farmers have become “commodity producing machines”, removed from their markets by instruments such as intervention and encouraged to follow a one dimensional “high output low cost” business strategy. The industry needs to reconnect with its marketplace, step away from the mainstream into specialist and niche opportunities, and focus on recapturing value through the upstream supply chain. In short, the industry needs its entrepreneurial flair back and cultural change is essential. The current shortage of Pillar 2 funds to provide support for business planning, marketing and training is of real concern, as is the ability of the Regional Development Agencies to deliver this support .

How do we get ‘there’?

It is also important to challenge the implementation set out in the Vision. The Vision offers no real road map to get ‘there’ except saying that “gradual and carefully managed change’ is a good thing. Is it really a good thing? All it provides is more uncertainty and the lack of ability to plan. What the industry needs now is clear signals to make it react and adjust accordingly. The gradual erosion of SPS over time (whilst appearing kind from some angles) will simply cause many to have a slow and painful death from the industry, haemorrhaging cash over the medium term rather re-structuring and re-aligning their businesses, or indeed exiting in a planned and dignified way now. Since the ultimate resource of agriculture (i.e. land) is finite, the ‘hangers on’ are simply constraining the entrepreneurs’ expansion which is no good for the long term interests of the industry.

So where to from here? If the rather unsatisfactory *status quo* rumbles on, then the cake is simply cut into ever thinner and thinner slices as the EU of 25 becomes 27 and then 30. As voluntary modulation ramps up and financial discipline wreaks havoc, the single payment in England may well be only £50/acre by 2012 or even less – and that’s before the effects of inflation, escalating fuel prices and the increased costs of ‘cross compliance’. ‘Park keeping’ for most is therefore not an option since it involves locking into this diminishing income stream with a questionable future after 2012. But inertia and often irrational decision making will simply mean many go on with loss making commodity enterprises, subsidising them through the single payment or from non-farming income.

What we need is a policy that delivers real industry solutions. Let’s pay for environmental enhancements in a proper way through the outcomes they deliver, not invent any more schemes that involve ‘ticking boxes’ (and for most ticking as few boxes as possible) to get modulated funds back (in the form of Entry Level Stewardship). What rationale is there for the continued basis of ‘income foregone’ being the payment reference point for schemes which deliver public goods? Let’s have policy that can assist with real business improvements (be they supply chain integration, diversification, exploration and exploitation of new markets for existing products or new products for new markets) and tackles ‘rural development’ in a proper way (incidentally, when we’ve actually decided what ‘rural development’ really means!)

The status of Agriculture taking 40% of the EU budget is unlikely to be

sustained in the medium term. As Harvey (2006a) discusses, the unique status of the CAP being 100% Brussels funded is of questionable sustainability. Co-financing by member states (and indeed part re-nationalisation of the CAP) would provide additional flexibility – because, once we fully decouple support from market prices and production, there is no longer any solid case for a ‘common policy’ – what we really want are common *outcomes* (i.e. an entrepreneurial and thriving rural economy with market focussed farmers of the future having viable businesses independent of support) not necessarily common policy instruments. Thus policies can be (or maybe even *have to be*) uncommon, differentiated and tailored to specific local, regional and national differences, to achieve this!

Conclusion

The “Vision” has at least promoted some debate. It offers few solutions, and is essentially budget driven (eliminate the policy; eliminate the cost [particularly to HM Treasury]). Industry and other stakeholders need to work together to offer a realistic alternative ‘Vision’ which will involve engagement with all about what kind of ‘agriculture’ the UK (and indeed Europe) wishes to have in the twenty first century, and thus what policy instruments are best placed to achieve this.

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Biographical Notes

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The above 'viewpoint' is an extended version of what was presented by Carl to the Environment, Food and Rural Affairs Committee Public Inquiry into the DEFRA/HM Treasury "A Vision for the CAP" – see http://www.parliament.uk/parliamentary_committees/environment_food_and_rural_affairs.cfm for more information.

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EDITORIAL

The articles in this issue represent a fine collection. Jack and Collison use a social science approach to analyse the use of gross margins. Elizabeth Jackson *et al.*, base their analysis on information gathered from Australian sheep farmers. The third, by Hubbard, Dawson and Scott, is an analysis of the economies of size in oil seed rape production in England. Finally, the fourth article reviews a workshop on Farm Risk Management which was organised by the Norwegian Agricultural Economics Research Institute, in Oslo, June 2006.

These papers show how new approaches can be used to tackle old issues. They analyse farmer's accounting practice and marketing behaviour using theoretical models of institutional practices and behaviour respectively. The third employs econometric analysis of data collected in a DEFRA survey of oilseed rape production in England to inform farmers about economies of size. The workshop review shows the importance of risk management in farming, and reviews some of the key research designed to understand and to assist farmers manage farm risk.

This editor hopes the Journal of Farm Management will continue to attract articles of this originality, importance, type and thoroughness in the years to come.

As this is the first issue of a new year, it is traditional to publish a list of editorial consultants: those people who have willingly given up their time to review articles submitted to the journal. It is largely because of the work of these people, and indeed the Editorial Committee, that the quality, coverage and standard of articles has reached these high levels. I would like to thank them for their work.

Jeremy Franks
Editor

REFEREED PAPER

GROSS MARGIN ACCOUNTING AS A SOCIAL PRACTICE*Lisa Jack and Martin Collison*

It is argued that agricultural gross margin accounting (GMA) is a social phenomenon with the characteristics of an institutionalised practice. This proposition is examined using the new institutionalism in sociology theoretical framework (NIS) drawing on evidence from the literature and interviews. Underlying social, political and functional factors (termed 'the antecedents of deinstitutionalisation' by Oliver (1992)) and the fragmentation of business processes at the farm level, suggest that the next few years will test the widespread advocacy of GMA in farm analysis by advisors and consultants.

Key words: gross margin, institutional practice, CAP reform, fixed costs, accounting.

Introduction

Agricultural accounting has a number of characteristics that makes it different to conventional accounting practices¹ but there is very little in the research literature that brings both together. Juchau and Hill (2000) note that the literature relating to agriculture, especially empirical studies, is 'sparse'. In academic accounting literature it has been stated that, "In spite of its relative importance in the economy of many countries and its growing interrelationships with other sectors, agriculture has traditionally not received much attention from accounting researchers, practitioners and standard setters." (Argiles and Slof, 2001: p.361).

It could just as easily be said that 'accounting has traditionally not received much attention from agricultural researchers' in the sense that the substantial amount of accounting academic research that has built up over the last thirty years appears to have had little impact on agricultural accounting². One strand of accounting academic research has been to analyse accounting as social and institutional practice (Hopwood and Miller, 1994), applying various interdisciplinary tools including social theory to examine accounting practices as they are actually used by people.

In this paper, the practice of using gross margins (GM) for planning, comparative analysis and reporting purposes is examined using an accounting and an institutional approach. It is argued that GMs are a socially-constructed

1. Differences in the UK would include a prevalence of single-entry bookkeeping over double entry bookkeeping at farm level; a less-defined divide between financial reporting and management accounting in agriculture than in so-called conventional businesses, with a heavy emphasis on comparative analysis and cash flow budgeting in agriculture; a broader range of accounting techniques and theoretical concepts within similar industries in conventional management accounting (including the development of activity based costing methods and non-financial performance measurement).

2. The lack of research by farm management academics using accounting methodologies may perhaps be related to economics being seen as the 'key discipline' of farm management (Malcolm, 2004) and the predominantly agricultural economics based nature of qualifications. Over the last thirty years or so, accounting as an academic discipline has become independent of the economics departments where it was once based and there is little non-capital market based interdisciplinary research. Conversely, accounting academics have been on the whole more interested in corporate and public sector accounting with only a few forays into food supply chains (e.g. Frances and Garnsey, 1996) or into the International Accounting Standard 41 *Agriculture* relating to the fair valuation of biological assets (e.g. Elad, 2004). Researchers in accounting tend to enter academia after working in the profession and initially, research follows their area of expertise: very few have made the transition from the food industries into accounting academia. Another route is for the researcher to come from other areas into a land-based university or college environment but again, they are relatively few in number.

practice because, although management accounting may be carried out by individuals, they employ this particular practice because books, advisors, teachers and software suggest that this is 'how things are done in farming'. But Dirmsmith (1998: p.69) suggests that researchers 'probe substantive domains wherein organizations are breaking-out of their traditional orientations and forms, and within which accounting and accountants may play different roles'. It will be further argued, using both a literature review and documentation generated by agricultural economists from the 1950s onwards and a contemporary investigation based on qualitative interview data collected in 2001-2004, that gross margin accounting (GMA) is an institutionalised practice, and that accounting practices have the potential to be transformed as the industry itself changes or to resist such a change. The analysis examines the conditions under which the practice might become de-institutionalised using the new institutionalism in sociology theoretical framework (NIS).

GMA is a phenomenon. It is a comprehensive, consistent accounting method applied voluntarily across a widespread industry made up of a number of different groups of actors (farmers, advisors, market representatives, civil servants and others). It 'burst on to the farm management scene' in the early 1960s (Giles, 1986: p.136) and was established within a very few years. Despite recognition of flaws (Giles, 1986: p.152; Warren 1998: p.78), GM exist in much the same format now as forty years ago but not necessarily in the format envisaged by their innovators. Bright (2003: p.599) observes that 'over the years the GM format has become deeply entrenched within farming parlance, data presentation and farm business appraisal ..., despite occasional dissenting strains, the recent take-off of benchmarking and the banks' interest in unit costs of production, the GM continues to hold sway'. In other words, the use of GM is an institution. Therefore, this study seeks to apply theories of institutions to unpack the institutional structures that have developed around this apparently straightforward and benign accounting practice.

This paper is structured as follows. The next section presents an historic account of GMA. This is followed by a presentation of contemporary evidence for the extent to which GMA is used in the industry. The next section examines why this can be interpreted as evidence of institutional practice and examines what have been termed the antecedents of deinstitutionalisation – the pressures that result in its reduced use. The conclusion considers the impact on the policy and practices related to the giving of business advice to farmers.

Theoretical framework

The identification and analysis of accounting methods as social and institutional practice is well established in the accounting literature (Miller, 1994). An institution can be defined as a set of rules and routines that are taken-for-granted and that have been 'infused with a value beyond the technical requirements of the task in hand' (Selznick in Scott, 2001: p.24). At its most basic an institution is, as Berger and Luckmann (1967: p.76) state, 'the way these things are done'. For highly institutionalised acts 'it is sufficient for one person to tell another that this is how things are done' for the institution to persist (Zucker, 1977: p.83). However, the term institution is somewhat static, suggestive of an entity that has certain properties, which has led to some

criticism that NIS studies can be descriptive and deterministic, merely 'black box' analyses (Zucker, 1977). At some point in time, the practice will have been initiated or evolved into its current form, and it is possible for a practice to die away, be replaced or terminated. In technical terms, there are processes of institutionalisation, reproduction and deinstitutionalisation. Hence the term 'institutionalised practice' conveys a sense of process as accounting practices are passed on and repeated over time, even where the historical reasons for their existence has been forgotten (Burns and Scapens, 2000: p.11).

There are two key concepts within NIS which make it a suitable theoretical framework for this study. The first concept is that of the organizational field and the second is the concept of the decoupling of the technical and the institutional aspects of institutionalised practices. Organizational fields are explained by DiMaggio and Powell as being 'organizations that, in the aggregate, constitute a recognized area of institutional life the totality of relevant actors' (1991: p.64-5). In this case, the organizational field is the agricultural industry in the UK. Resistance to change is a feature of institutions and new institutionalists are concerned with the question of why institutions persist, largely unchanged, over time (Powell and DiMaggio, 1991: p.13). What is interesting in the case of agricultural accounting is that resistance to change in agriculture is not observed in the uptake of technological advances (which are on the most part rapidly taken-up by farmers) but is manifest in the field of accounting.

Decoupling refers to the discrepancy between formal structures and organizational practice, and to the assignment of 'the spread of rationalized procedures and rules to cultural rather than technical processes' (Carruthers, 1995: p.315-6). Yet the difference between technical and institutional features is not easily drawn, as 'those who formulate institutional rules strive to make them institutional in nature' (Scott and Meyer, 1991: p.124). One of the aims of this study is to uncover the institutional features of gross margin accounting. These institutional factors - 'cultural-cognitive' aspects (Scott, 2001, p.48) – cover the consideration of legitimacy, power, the transmission of stocks of knowledge, including the effects of unintended consequences and simplification over time and space (Jack, 2005), and other cultural considerations. Most importantly, although the institution may be manifest in various artefacts and verbal designations, the institution only exists in the actions of humans in producing and reproducing the institution over time (Scott, 2001: p.48).

This study also adds to the literature concerning the diffusion of institutionalised practices: Fligstein (1991: p.335) comments that the functioning of organizational fields is not well understood and that 'one main issue concerns the way diffusion processes work and the role of networks as a source of diffusion'. At the other extreme, as Zucker points out (1977: p.105), 'there has been very little work on the processes by which institutions disappear'. Oliver (1992) suggested a framework for the study of the process of deinstitutionalisation that examines the functional, political and social pressures on institutions that might lead to their erosion or disappearance. This paper suggests that these so-called 'antecedents of deinstitutionalisation' can be observed in the agricultural industry. However, on their own they do not account for all the changes being seen. Indeed it could be argued that much of the change in agriculture which is leading to deinstitutionalisation is internal and

being driven by farmers themselves.

The method adopted for this study is one of investigation into episodes in the life of the institution, suggested by Giddens's theory of structuration (Stones, 2005: p.135). By examining the point at which the practice was institutionalised and a later point at which it is still practised, the aspects of the practice that have been chronically reproduced over time and space can be identified. The historic episode has been investigated through extant documents, including published research, technical publications and artefacts such as computer reports, and through discussions with some of those who remember the period (including John Nix). The contemporary episode has been investigated through publications and through a number of semi-structured interviews with actors in the field. The number of interviewees chosen was not designed to be representative but rather to give some insight into how the practice is used and viewed by the industry. Farmers were sought who had diversified their businesses in the period c.2000-2002 and who had some level of further or higher education, as previous research had found that such farmers were most likely to use more advanced accounting practices (Norman, 1986; Read, 1986; Schnitkey et al. 1991). Such farmers were also likely to have had a need to review their accounting practices. Other interviewees included an agricultural partner from a major accounting practice, a management consultant from a major firm of consultants, advisors from a scheme sponsored by the East of England Development Agency, civil servants, bank managers, academics and a representative from one of the units running the Farm Business Survey. By 'floating' over the institution in this way, as Stones (1996: p.77) describes this method of research, patterns of chronically reproduced practices could be observed and analysed.

Gross margins as institutionalised practice

GM figures are used widely in the agricultural industry in the form of forecast figures for use as an aid in budgeting (Nix's Farm Management Handbook being the most well-known but there are many others), as benchmarks in consultant's reports, in most reputable farm computer packages, as indicators in the farming press, in teaching materials, in conferences and presentations and in government publications, such as the recently issued government document on farm management accounting (DEFRA, 2004).

And as 'agricultural accounting' they take on a 'value beyond the technical requirements of the task at hand' as Selznick characterised institutions (Scott, 2001: p.24). They appear to be 'taken-for-granted' as the way in which agricultural accounting is done (Markham, 1999). There are rules for their calculation and the use of the GM in account formats is routine. What is also routinised is the classification of costs into variable and fixed, using the agricultural rather than the conventional definitions of those terms, and the difficulty in introducing other terms (Warren, 1998): this is in contrast to conventional management accounting where different sets of terms are available in the toolkit.

Net margins and cost per unit calculations have at various times been championed but although in use, they have not dislodged the GM as the basic element of agricultural accounting (Bright, 2003, p.599). The original use of

‘GM planning and analysis’ as advocated by Wallace – as an accounting technique for maximising marginal gains from the mix of productive enterprises undertaken – appears to have been lost in practice. Although still advocated in textbooks, the authors were told ‘no one does a Barnard and Nix’ (i.e. few follow the textbook rules). The technique in its original form is applied to the assessment of potential marginal gains but only for ‘difficult cases’ where all other means of improving profit had been attempted, as one bank manager explained. The most common use of GMs is as formal or informal benchmarks, which Giles (1986) declared to be ‘their least safe use’. The simplification of GM analysis into formulae and formats follows a characteristic of institutions (Berger and Luckmann, 1967, p.87). In the course of our interviews, mixed views were expressed on the usefulness of GM accounts but in general interviewees thought that they ought to be used or used them because they were thought to be expected. Documentation suggested that GMs were the basis of the layout of agricultural enterprise calculations, even where consultants and others admitted to using other techniques and to assessing situations differently in their minds, an element of decoupling. The most popular use of GMs is for comparative analysis, and it is this conflation of ideas and the development of legitimacy associated with it that will be followed in the reporting of findings below.

GMA is a human invention or construction, a means of creating a reality (Armstrong 2002, p.281). It has an identifiable historical starting point, a period of diffusion and institutionalisation, a long period of reproduction and the possibility of deinstitutionalisation. There are associated discourses relating to the accounting practice found in agronomy reports and the farming press which promote ‘maximising gross margins’ as a strategy for successful farming, which is, of course, on its own a misleading approach. GMA is more than an institutionalised discourse about how farming success should be measured or how agricultural accounting ought to be done. The method is practised, and there is physical evidence of its use. There is also evidence that has persisted over a period of forty years (or fifty years if the institutionalisation of comparative analysis is included) and continues to persist, despite changes in the industry and the pressures upon it. The researcher was asked a number of times during the course of the interviews and in presentations ‘so, what is the problem, if it works?’ There may be a functional problem with GMA but that analysis is outside the scope of this project. What is known is that changing environments elsewhere have stimulated change in accounting practice, often associated with the analysis of overhead costs. These debates of ‘relevance lost’ (Johnson and Kaplan, 1987), of the Cambridge Controversies³ and the impact on accounting measures (Tinker, 1980) and the more recent ‘Beyond Budgeting’ (Hope and Fraser, 2003) debates, which argue that traditional annual budgeting processes should be replaced by simpler, adaptive, low cost, relevant models based on key success factors, may well have resonances in agriculture, where budgeting models particularly have been applied with uneven results (usually attributed to the largely unpredictable occurrences of weather and disease).

3. The Cambridge Controversies were so named after disputes between the Universities in Cambridge, Massachusetts and Cambridge, England over the theoretical links between the production function and the processes of capital accumulation and growth in Economics. For a good introduction, see Cohen and Harcourt, (2003).

The history of gross margins as an institution

The story of the introduction of the GM into popular use in the UK has been amply covered by Giles (1986), who in turn drew heavily on Lloyd (1970). The main champion of GM analysis was David Wallace, who at the time (c. 1960) was the Farm Management Liaison Officer (FMLO) based at Cambridge University. FMLOs were put in place to liaise between the National Agricultural Advisory Service (NAAS) farm advisors created following the 1947 Agriculture Act and university based economists who were providing interpretations of the data collected by the NAAS workers in the field. David Wallace was not the originator of the method: he drew on the work of Liversage (1956) who had in turn resurrected an idea first brought to the attention of agricultural economists by King in 1928 (Lloyd, 1970: p.7). As Rogers (1996: p.259) says, though, innovations belong to those that popularise them and see a need for them. For an accounting method, the GM had quite an exciting beginning. Wallace championed the method through meetings, through the BBC and through his associates (including John Nix) and published his initial findings in 1959. By 1962 John Nix, now at Wye College, was teaching the method to students and by 1964 the *Journal of Agricultural Economics* had published an article by Upton (1964) whose style implies that the use of GMs is now taken-for-granted by academics and advisors. Nix's handbook was first published in 1966 and by the early 1970's, the GM was in 'almost universal use' (Nix, 1979: p.284). The theoretical underpinning of the method was consolidated by Barnard and Nix (1979).

Wallace developed GM in response to the difficulties resulting in using whole farm comparative economic analysis. It was the first innovation to be brought in by the FMLO in response to their remit to provide economic tools for use in the field by NAAS. In the booklet to accompany the BBC broadcasts, they stated that, "We believe that the whole business of farm costing and accountancy has been made far too complicated and that the complexity of the various systems that have been erected has, if anything, tended to widen the gap between the man on the farm and those who are trying to help him." (Selly and Wallace, 1961: Introduction).

Comparative analysis, which compares on-farm data to 'yardsticks' derived from economic surveys, had itself been something of an innovation in the early 1950s. Yet because the number of comparators increased, completing complex data sheets slowed farm operations, university economists were needed to help interpret the data, and although attempts were made to computerize the process, the whole approach was becoming unwieldy. Moreover, "When management accounts were introduced around 1950, food was still scarce and high output was obviously in the national interest ... (now) high output under these conditions is no longer profitable. The GM (which allows for these costs) is thus a better measure than output of the real contribution of crops and livestock to the farmer as an individual and to the nation as a whole." (Sturrock, preface to Wallace and Burr, 1963).

Wallace's touch of genius was to link the calculation of GM to forward budgeting and planning, and to emphasize the need for farmers to maximize marginal income and to control costs in order to increase their net incomes. This appealed to current government thinking as well, which was turning away from

the need for high productivity and price support mechanisms (Tracy, 1964). GM analysis and planning was emphatically not an alternative form of whole farm comparative analysis: each farm was looked at on an individual basis, enterprise by enterprise, and the mix of crops (the method was originally aimed at arable farmers) adjusted to create optimum returns. Linear programming was promoted as a suitable method for calculating these optimal mix figures.

However, this version of the GM is not the one that has survived and implemented. Sometime during the 1960s, GM analysis became a popular basis of comparative analysis. As Giles explains (1986: p.147), “Experience suggests that despite the twenty or so years that have elapsed [i.e. ~1960-1980] since David Wallace put the spotlight on the GM – and despite its general acceptance – this measure can still sometimes be misunderstood and misused.”

The use of GM in comparative analysis led to the production of standard GM. Wallace found that in the field, the NAAS advisors trained to use GM planning and analysis found that they needed standardised reference data against which to make their assessments of the farm data they were analyzing. Further, teachers and students required data reflecting actual practice, which led Nix to produce his handbook (Nix and Hill, 2002) very much as an aid to budgeting and not as a set of benchmarks (and it is still seen by Nix as such, Pers. Comm.). Yet the transmission of the agricultural GM since the 1960s has been as a format and as a tool for comparative analysis, and thus standardized has endured to the present day, despite the inherent weaknesses associated with the time lags in producing data and the need to modify farm accounts to provide like-for-like comparisons.

Gross margin accounting in current times

The following briefly summarises the different practices of farmers, advisors, consultants (private and governmental) and academics discovered through interviews and a review of current documents and other literature.

Farmers, on the whole, do not calculate GMs, although anecdotal evidence from advisors suggested that a very small number did use quite sophisticated planning methods. Only one farmer in this study (a former farm secretary) used the GM budgeting facilities in their farm software package. She commented “Before we started all of this [a dairy diversification] I was always using the budgets for the farm but ...to be honest with you, now we’ve only got cows and a bit of wheat, there’s not a lot of budgeting to do”.

A practicing farm secretary seemed to sum up the generality of practice in describing the use of the top of the range computerized package used by one of her clients, “I use it for inputting all the sort of accounts information. And then he uses it for doing cash flows and tying up with the bank throughout the year. So, he, out of anyone, he’s the only one I know that actually uses the accounts to any sort of purpose rather than me just doing it and it being presented to the accountants at the end of the year.”

The most successful farm in the survey employed a full-time management accountant and support staff. They used a well-known farm software package, but did not use the GM facilities, “We’re looking at the costings (i.e. overheads). If we’re investing X hundred thousand in a year in different assets, then you’ve got to take various costs out. At the end of the day, the thing we

worry about most is cash... It's, where is the bank balance? Father gets that figure every day."

Furthermore, when asked if they used GMs the reply was fairly robust, "GMs... we don't, no...I think we're shooting ourselves in the foot with it as a selling tool because too many people can work out the GM fairly easily."

Concerning inter-farm comparative data, three of the farms declared that they had only a very passing interest. Of the others, one farmer was an enthusiastic participant in the farm business survey seeing it as a reassurance that his farm was doing no worse than any other. Another expressed concern that the figures given to those that collected the data were too good to be true, given the evidence of going around such farms on official 'farm walks'. She also made the telling throw away remark that since they had diversified into making dairy products they were 'not like any other farm now'. The successful farm quoted above was also skeptical about benchmarking or other comparative scheme: they did take part in the Meat Livestock Commission's pig scheme but 'it's just an interesting benchmark' and not used for planning purposes.

Yet, farming is, as Newby (1984: p.99) stated, 'a highly visible activity, especially to other farmers'. Farmers are insatiably curious about the success or otherwise of their neighbours, but they cannot see their financial results: it is commonplace for a farmer not to disclose the results of the business even to their spouse or children. Therein lies the attractiveness of comparative analysis to farmers: it allows the farmer to see what other farmers are doing, and to gain reassurance that they are doing well enough themselves. There was no evidence here that the results gave them a kick to change their own performance, although the possibility of such a kick is made elsewhere (FCC, 2003).

Between times, there have been attempts to supplant the use of GM, Giles's (1986) advocacy of net margins is a case in point, but although there is evidence that these are used by advisors, the public documents are still cast in GM formats. Similarly, neither cost per unit calculations or full-costing have supplanted GM as the basis of performance measurement or agricultural accounting (Warren, 1998; Bright, 2003). Highly institutionalised practices usually see off their competitors. Besides, as Nix commented, there appears to be a view that 'the farm management job is done', meaning that many academics or practitioners believe that all the required tools for financial planning and analysis have been found and no further change is needed (1979: p.289). There is an attractiveness about GM accounting and comparative analysis, as commodities, that make them digestible and, as one advisor said, sufficient for most of the problems found on assignments.

The Antecedents of Deinstitutionalisation

Logically, if an accounting practice can become institutionalised, it can also become deinstitutionalised: the practice can diminish or disappear from use over time. The process of deinstitutionalisation may be accelerated by pressures that promote the entropy of the practice whilst other pressures (termed 'inertial' in the literature) may protect the practice and resist (Oliver, 1992: p.567) its dissipation or rejection by actors in the field. Oliver (1992: p. 566-7) groups the so-called antecedents into three categories; functional pressures, political pressures and social pressures. In this section, three potential antecedents

relative to GMs are considered: an emphasis among farm advisors on the control of fixed costs; the decoupling of subsidies from production and social changes in rural communities.

It was evident from interviews with consultants and advisors that the key focus of advice at present is on the overhead costs associated with machinery, labour and farm occupancy. Different interviewees referred to a phenomenon they called variously the ‘variablisation’ or the ‘fuzziness’ of fixed costs. Jones (2005: p.240) explains that greater outsourcing via machinery rings, casual labour and contracting ‘will not just affect the level of costs but also their nature – making them less fixed and more variable or ‘discretionary’’. Others noted that they would like to see costs per unit – e.g. per tonne or per litre developed as an alternative to costs per hectare.

GM accounting and analysis does not ignore fixed costs as Barnard and Nix (1972, p.46) are at pains to point out – for any marginal analysis to be of value, fixed costs have to be covered by the total farm gross margin - but it does tend to focus the farmers attention on the need to control variable costs of production. The original intention of GMA was to maximise marginal income, which has been more or less overshadowed by the use of GM in comparative analysis as a measure of production efficiency. Farm management decisions are becoming more strategic or operational (for example, the removal of enterprises, changing from year round to block calving, diversification) rather than marginal or tactical. This was observed by Giles (1986) when he called for net margins to be used rather than GM – something probably even more relevant today. Hence the functional pressure on the practice could be summarised by saying that non marginal decision making requirements should provide a point of pressure for non-marginal accounting techniques and discourses to be developed.

The most significant political pressure on farm decision making at present is undoubtedly CAP reform and the decoupling of subsidy from production. Jones (2005) explores the potential for farmers to withdraw from production whilst retaining land in order to fully benefit from the Single Payment on offer. The removal of subsidies from GM calculations makes a significant difference (p.247) and may impact on decisions relating to production. More significantly, he finds that farms with a highly flexible overhead structure have a greater incentive to quit production whilst smaller, less flexible farms may decide to farm selectively in order to be cost competitive (p.246). This suggests that a much broader perception of cost management and marginal profits is coming into play. Jones (2005) observes that ‘It has tended to be taken too much for granted that the only means of achieving satisfactory profits has been to achieve economies of scale ignoring the diseconomies’: it is certainly the case that in tables stratifying farm incomes and in certain benchmarking groups, the most profitable farms are sometimes neither the largest nor those with the greatest yields.

Whether a social restructuring is genuinely taking place in the countryside in a post-productivist environment has been widely debated (Evans et al., 2002; Hoggart and Paniagua, 2001; Burton, 2004; Jack, 2006). Clearly, farmers are under significant stress (HSE, 2005) and the number of working farms in the UK has been reduced. Whether this constitutes significant social pressure on accounting practices is still hazy but there was some evidence in the interview

data between farmers who had diversified into on-farm production activities or contracting out, and the increased use of record-keeping and management information. The definition of what constitutes a farming business is changing in some cases away from purely agricultural production to multiple activities (Collison, 2002) and one consequence of this that the farmer comes into contact with a greater array of businesses and customers, which in turn might influence the business practices in the farming business. A greater awareness of prices that could be charged was cited by a number of interviewees in this context. The data in this study, however, was insufficient to predict trends or consequences arising from these observations.

Thus there are functional, political and social pressures, of which only three have been touched on here, which may lead to the diminishing use of GMA and possibly its deinstitutionalisation. There are a number of other contrary pressures that exert a considerable pressure and which prevent or slow down the dissipation or rejection of the practice. Among these are computerisation, teaching practices and published texts.

Computerisation offers opportunities for more complex calculations and the ability to create more flexible decision making systems. Malcolm (1990: s.2.70), in reviewing the work of farm management academics and advisors in Australia in the period 1940-1990, concluded that, "The resilience of the appeal of farm recording and comparative analysis after the production economists' early critique was closely tied in with the development of the capability for computerised collection and analysis of data which occurred in the 1960s, and the potential this was perceived to hold for the standardisation of the accounting process."

However, computers also introduce rigidity into practice. All available farm accounting programmes examined as part of the research into this project had decision making elements based on gross margin accounting. Consultants and advisors have invested in computerised reporting based on GM formats. Benchmarking packages also return results in these formats. Software programmers rarely innovate new techniques but mimic accounting patterns already in use as in the development of spreadsheets from paper based originals.

Similarly textbooks and teaching curricula can follow innovation rather than produce it (one consultant interviewed lamented the lack of innovation in business planning and methods presented in competition entries from those on agricultural courses). DEFRA (2004) perpetuates the use of GMs, although recent special reports have employed net margins. Programmes, books and curricula provide formulae and artefacts which are crucial in the preservation of institutions (Berger and Luckmann, 1967). Conversely, therefore, new innovations may be diffused through these media, and the potential of farm computer software in strategic decision making has not yet been fully exploited.

Conclusions

GMA is not valueless: all businesses need to know and to control their variable costs and evaluate the contribution of individual enterprises. However, it is a weak tool for comparative analysis and for strategic decision making. It should not disappear entirely but the current pressures on the use of GM analysis identified here will probably be sufficient to promote acceptance or at

least trials of new innovations and the promotion of a wider discourse which encompasses all costs and revenues. Accounting innovations drawn from other sectors already being tried and discussed by agriculturists in the UK, Australia and New Zealand involve benchmarking groups, balanced scorecards, non-financial or alternative performance measures, relevant cost-benefit analyses and target costing.

An awareness of the institutional nature of accounting practices and their durability, even when under external pressure, should sensitise policy makers, academics and advisors to the need to question accepted practices and review their effectiveness and relevance. There are those that believe that until farmers have grasped GMs, variable and fixed costs, it is too confusing to introduce another system. Yet as explored above, these terms are becoming blurred and may actually hinder farmers 'knowing their costs'. For those farmers seeking to position themselves strategically in supply chains and global markets, who have used GMs so far, more sophisticated tools will be required in the future: it is likely that farmers themselves will provide the environment in which innovation occurs.

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REFEREED PAPER

**EVALUATING PRODUCERS' PERSPECTIVES ON
SELLING RAW WOOL: A FIELD STUDY OF
BEHAVIOURAL FACTORS AND VARIABLES**

Elizabeth Jackson, Mohammed Quaddus, Nazrul Islam, John Stanton

This exploratory field study revealed that pricing, complexity, business process improvement, dominance of the auction system and production risks are the major considerations of farmers when making choices regarding the method of selling their raw wool. Content analysis of data gathered from four focus groups conducted in regional Western Australia was combined with Fishbein and Ajzen's theories of Planned Behaviour and Reasoned Action, as well as Rogers' Diffusion of Innovations to construct a behavioural model of wool producers' intentions to sell raw wool by forward contract.

Keywords: Wool production, forward contract, auction, focus groups, qualitative analysis.

Introduction

Australia is the world's largest supplier of apparel wool (Lowe, 2005) and earned the nation \$2.34 billion worth of export income in the 2004/05 financial year (Wahlquist, 2005). Wool prices have been falling since the 1990s largely due to a decrease in global demand from the highly competitive price and manufacturing characteristics of substitute products, like cotton and synthetics (Perry, 2005; O'Donnell *et al*, 2005; Ashton, 2003). While China is a large and secure buyer of over half of Australia's wool (Bolt, 2006), its domestic demand for the commodity, which accounts for 65% of the Australian wool exported to this market, has been falling (Perry, 2005; O'Donnell *et al*, 2005). Medium to long term forecasts for wool prices also reflect bad news with sheep numbers likely to increase as mixed grain/sheep producers re-stock their properties after the 2002/03 drought (Perry, 2005). While there will be more sheep, the extra wool produced will enter a market in which a lack of improvement in demand for wool has been attributed to the predicted slow-down in the global economy and difficult economic conditions in Europe, the United States and Japan (Perry, 2005; The Woolmark Company, 2005).

Decline in wool prices since 1989 have seen woolgrowers' incomes suffer and specialist wool growers have seen negative farm-business profits (Kingwell *et al*, 1999; Shafron *et al*, 2002). The Woolmark Company (2005) has said that price declines are due to factors such as poor economic conditions in continental Western Europe, a dip in Japan's economic growth, declining value share in women's wear and low cotton prices. Further to this, a lack of improvement in demand for wool has been attributed to the predicted slow-down in the global economy and difficult economic conditions in Western Europe.

So if everything is so difficult in the Australian wool industry and it is fraught with so many anomalies, why do farmers continue to produce wool? A recent study asked this question to three groups of Western Australian farmers

(Islam, 2003). The research found that there are eight factors driving farmers to produce wool – only two of which were finance-related. The other six factors were behavioural types: living in the country, past experience with wool, personal interest to produce wool, property set-up to produce wool, wool is a unique natural fibre and use of latest science and technology.

Such findings are supported by Herrmann and Uttitz (1990) whose work on rural sociology found that factors such as 1) traditional bonds with agriculture and that 2) the farm is more of a home and living space than it is a workplace are reasons why farmers stay on the land. In terms of finance, however, Smith (2001) found that Western Australian farmers will continue to raise sheep despite earnings from this enterprise falling below break-even point. Sheep enterprises will continue to be run for the mutual benefits to other on-farm enterprises such as weed control and the suppression of chemical resistance to weed species (Cottle, 1991).

This qualitative research explores the thoughts, feelings and opinions of Western Australian wool producers on the current methods available for selling raw wool with the aim of adding to this body of literature on why farmers continue to produce wool. Wool producers from four regional locations in Western Australian were asked to discuss their views on selling wool as a vehicle to gather data for this qualitative research project. In the next several sections background literature, theoretical frameworks and research method are presented. Results of the study are followed by discussions and research implications. The paper is closed with conclusions drawn from the research and suggestions for future study.

Background

Research shows that Australian farmers are likely to experience greater fluctuations in commodity prices in the future (Kingwell, 2000) yet some 85% still sell their wool on the open-cry auction system (Bolt, 2004) and only 11% use the more risk-averse forward market system (Coad, 2000). It has been suggested that use of forward contract is one mechanism available to farmers to minimise the risk associated with selling agricultural commodities (Barnard and Nix, 1979) and thus stabilise income. This research seeks to understand how local wool producers feel about forward contracting, and other systems of selling their raw wool. Further to this, the knowledge gained from this study will be used to construct a behavioural model being developed to identify the factors affecting the adoption of forward contracts by Australian wool producers.

Auction system

The wool auction system has operated in Western Australia since December 1920 (Countryman, 2004) and is described on the Department of Agriculture and Food Western Australia's (DAWA) WoolDesk web site as follows: "Farm wool is mainly sold through open-cry auctions in Australia. These auctions are conducted by Australian Wool Exchange (AWEX) on behalf of the Australian wool producers, the wool brokers and the buyers." (WoolDesk, n.d.).

Not only is auction an established method of selling wool but it is also the most popular with 85% of wool being sold this way (Bolt, 2004). Seale (1996) lists the advantages of the auction system as being an efficient means of aggregating the sale of wool from many producers who are geographically dispersed, it provides the widest possible exposure to buyer competition, it is the preferred buying method of most wool exporters, wool quality is openly specified and there is maximum financial protection for the buyers and sellers. In addition to this, the disadvantages are listed as being the extent of price volatility, the dependence of buyer frequency on competition and the low average lot size. In opposition to this view, the Wool Industry Review Committee (1993) found that 31% of Australian wool producers are dissatisfied with this system and said it to be “defective due to volatility, [exposed to] possible manipulation, [have] unpredictable time constraints and [be] an unnecessary intermediary participation in the communication channel” (p. 75).

Futures

The Australian industry took a backward step to enhancing selling alternatives for growers in August 2004 when its principle futures broker, Macquarie Bank, closed its wool futures service. The main reasons given for this move were that it is not attractive for growers to hedge due to the fact that the forward market tends to yield lower prices than the spot market due to the lack of support for this service from growers. The suggestion was made that at least 20% of the national clip has to be forward sold before healthy prices can be achieved and more fluid trading commences. At present it is estimated that only 3-5% of the national wool clip is sold using futures (Cuming, 2004).

The benefit of futures, as with forward contracts, is that they are a method of managing price risk (Mitchell, 2003) however the futures market also provides wool buyers with a forum to offset the price risks associated with taking out forward contracts with producers (Lubulwa *et al.*, 1997). This was the greatest disadvantages of Macquarie Bank's withdrawal from the wool futures market as it meant that Australia's forty registered wool traders (Champion and Fearn, 2001) lost one of the strongest agents for securing their business' against the risk of significant market price movements (Cuming, 2004).

Forward contracting

The Wool Industry Review Committee (1993, p. 76) defined a forward contract as “A binding contract specifying the price (or price formula), quality and quantity of a product to be delivered at some specified date. The quantity may be expressed in units of output or as the production from a specified area. The contract usually specifies penalties to be exacted from each party for particular kinds of non-fulfilment”.

What can be gleaned from the above definition is that no matter how one looks at forward contracts, such a selling mechanism is characterised by a set price and set delivery date for a specified commodity. The principal benefits of

forward contracts to farmers discussed in the literature are based on the concepts of price risk management/uncertainty and income stabilisation (Barnard and Nix, 1979; Miller, 1986; Musser *et al*, 1996; Fraser, 1997; McLeay and Zwart, 1998; Coad, 2000; Kingwell, 2000; Champion and Fearn, 2001; Bolt, 2004; Brakenridge, 2004; Cuming, 2004; Liddle, 2004).

Many authors discuss the risk-averse nature of farmers (Bond and Wonder, 1980; Pluske and Fraser, 1995; Coad, 2000 and Pannell *et al*, 2000) and comment on the benefit of forward contracts in terms of their stabilisation on income. Barnard and Nix (1979) provide a British agribusiness definition of forward contracts and aptly describes them as a tool of turning price uncertainty into price certainty. Despite these benefits to growers and industry, Coad (2000) found that only 11% of producers sell their wool by forward contract in Australia. It is therefore the aim of this study to understand the advantages and disadvantages of the currently-available wool selling systems – as perceived by local wool producers. Are they aware that the forward contract system exists? If yes, why is it so sparingly utilised?

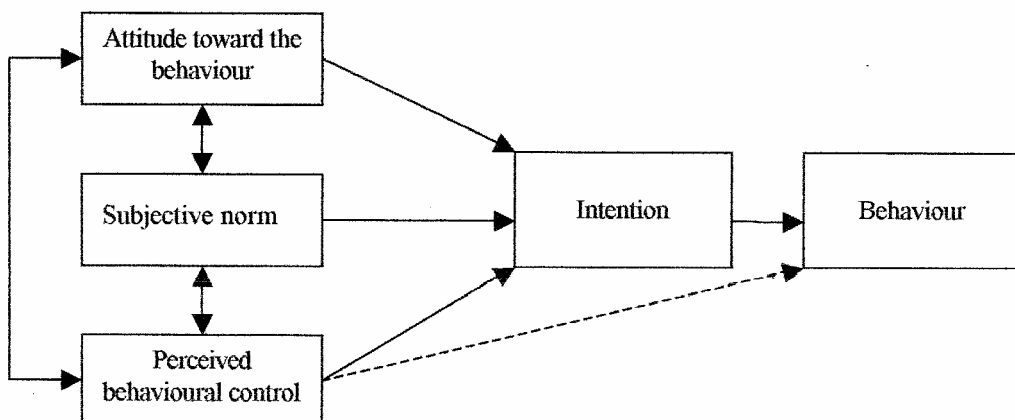
Theoretical frameworks

Two well known behavioural theories have been used as background to this study and are described below with special reference to their applications in the agribusiness research area. It must be strongly emphasised that this research is not attempting to replicate these predominant theories but they are merely being used to provide a framework from which to start. It is anticipated that findings from this research will call for them to be adapted to suit the farm-level decision making environment.

Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB, Figure 1) uses the knowledge of attitudes, subjective norms and perceived behavioural control to understand beliefs and thus explain behaviour. It is an extension of Fishbein and Ajzen's 1975 Theory of Reasoned Action (TRA) that uses perceived behavioural

Figure 1. Path of model for the Theory of Planned Behavior.



control to predict behaviour in two ways: through motivational factors and the intention to perform the behaviour (via the 'Intention' construct). There is also a direct link in the TRA between the 'Perceived behavioural control' and 'Behaviour' constructs which is not mediated by intention (Madden *et al.*, 1992).

Since the TPB was first published in 1985, research has been conducted to show that not only is there significant relationships between the theory's constructs but that it is possible to include other factors. Ajzen (1991) had the foresight to predict that this would be the case and, more than ten years later, Burton (2004) cites studies that have successfully integrated additional factors to the TPB on an "as needed" basis. Such factors were listed as habit, moral obligation and self-identity although it was only the construct of "identity" that Burton (2004) nominates as worth using in farming-based social psychology research.

Despite any criticisms that have been made, research by Beedell and Rehman (1999) have proved TPB to be a suitable tool for measuring farmer behaviour in two ways: to find out if all farmers behave in the same way and if not, are the differences in their beliefs explained by difference in their behaviours? The TPB was also successfully used by Lynne *et al.* (1995) in explaining the technology adoption behaviour of strawberry farmers, however research, in terms of agribusiness, is limited predominantly to the adoption of farmers' conservation behaviour (see Beedell and Rehman, 1999 and 2000; Lynne *et al.*, 1995; Burton, 2004).

While literature exists on explaining the adoption of technology using TRA and TPB, there has been little research found on adoption of improved business processes, such as the use of forward contracts to sell agricultural commodities. This is where this research aims to add to current knowledge on agribusiness systems.

Diffusion of innovations

Diffusion, a prominent theory in the rural sociology research domain, is defined by Rogers (1995, p. 5) as "the process by which an innovation is communicated through certain channels over time among members of a social system" and has successfully been applied in rural contexts since the 1940s (Fliegel, 1993) with the foci being on the adoption of agricultural ideas such as weed sprays, hybrid seed and fertilisers (Rogers, 1995). Recent trends in literature on diffusion in agricultural technologies have been in the adoption of modern farming systems in developing countries (Masters, 2005; Abdulai and Huffman, 2005; Weir and Knight, 2004; Munshi, 2004; Rahman, 2003; Neill and Lee, 2001; Mishra and Hossain, 2000) and the adoption of biotechnology innovations in farming systems of developed countries (Hategekimana and Trant, 2002; Stewart *et al.*, 2002) – or both (Qaim and De Janvry, 2005; Palaez and Schmidt, 2002).

Many authors who have studied the empirical nature of diffusion (such as Ajzen & Fishbein, 1980; Quaddus and Xu, 2005; Ryan and Gross, 1943) take a classic, linear view to the process whereby external factors contribute to perceptions which, in turn, give rise to the utilisation of technology. Rogers

(1995) presents a version of this linear model of the diffusion process within agriculture (Figure 2). However, Fliegel (1993) illustrates a more widely accepted approach to the adoption of agricultural innovations. He argues that the classic approach tends to restrict the process of diffusion to be a rational, planned process that relies on the developments of institutions such as government departments, rather than viewing the farmer as a passive individual who responds to more random forces related to social participation and communication (Figure 3).

This model is the version chosen for the present research as it better aligns with environment in which farmers chose methods to sell their wool, that is,

Figure 2. Diffusion as a linear phenomenon.

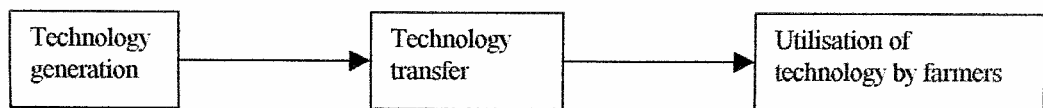
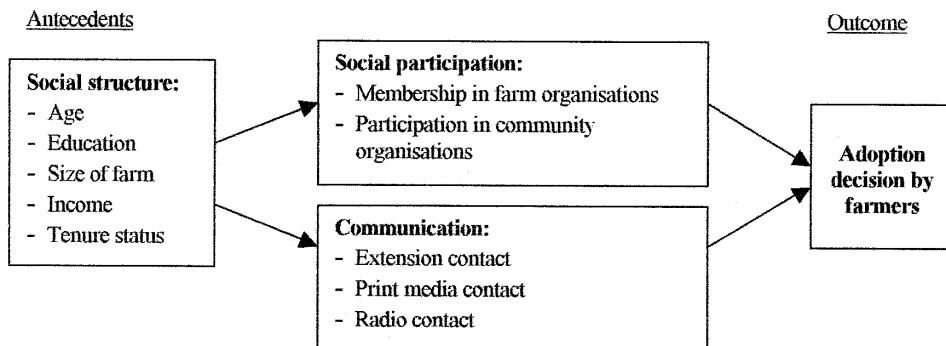


Figure 3. Fliegel's approach to the adoption of agricultural innovations.



relatively free of institutional impact from organisations such as government departments and the well-established nature of the wool trading industry.

Research method

One of the aims of this study is to build a behavioural model based on qualitative, exploratory research that can later be tested using quantitative, confirmatory analysis techniques. To achieve this, Grounded Theory was employed as it "is a method based on symbolic interactionism, used to explore process" (Morse & Richards 2002, p. 156). To observe such symbolic interactionism and document the attitudes and processes undertaken by farmers when selling wool, it was most apt to conduct focus groups (Zikmund, 2003) for collecting data. This qualitative research method allowed the

researchers to gather the opinions of real-life sellers of raw wool in an environment that was flexible for the free-flowing of spontaneous and unstructured ideas based on genuine thoughts and feelings (Sekaran, 2003; Wilkinson, 2004). Participants for the focus groups were invited from local knowledge of DAFWA employees. The information generated from these focus groups is not intended to definitively represent the opinions of all Western Australian wool producers but will be combined with evidence from an extensive literature search to give strength to a model constructed to understand the behavioural determinants of farmers using the forward market to sell their wool.

Sample

Convenience sampling, often used for business research (Zikmund, 2003), was principally used to select locations and participants for the focus groups. Voluntary participants for all focus groups were selected through the researchers' various industry contacts; some participants were invited on personal contact. The only selection criterion was that participants had experience in selling wool within Australia. Potential participants were contacted by telephone, fax and e-mail. Focus groups were conducted in areas of varying wool production of Western Australia: Northampton, Merredin, Kojonup and Esperance with participant numbers ranging from two to eight people per focus group. There was a total of twenty-six participants.

Data collection

This exploratory research is characterised as interpretativist since it attempts to form structures from the interpretation of opinions. Focus groups are described by Sekaran (2003) and Zikmund (2003) as being unstructured to allow for spontaneous and free-flowing dialogue amongst the participants. They were used here to seek people's descriptions and experiences of selling raw wool by forward contract and also to enhance the concept of human interaction on discussing ideas to develop solid structures about the pros and cons of forward contracting (Fisher, 2004).

It is for these reasons that five fictional, loosely structured scenarios were used as the primary vehicle to collect data. The principal use of these scenarios was to conduct a generalised, but not necessarily representative, situational analysis of the thoughts, feelings and opinions of Western Australian wool producers so the behavioural model being developed, based on the literature, would have real-world substance. Prior to conducting the focus groups, a pilot session was run with four members of the research team and an external facilitator.

The four focus group sessions were conducted in the previously specified regional locations with wool producers. For these sessions, Curtin University's Mobile Group Support System (MGSS), installed with AnyZing 5.0 software (<http://www.anyzing.com/>), was used to run the meetings and capture the data. This technology allowed focus group participants to electronically record their responses in anonymous "play spaces" that were projected onto a central video

screen for further discussion. An IT person and observer were also part of the research group to assist with computer operation and data collection during the focus groups.

The script format for these sessions used scenarios to encourage participants to express their views without introducing bias about specific issues. The scenarios revolved around a fictitious character, Bob Smith, who was said to be an experienced grain producer but had very recently purchased a property next door and needed advice on how to sell the wool from the sheep that had been sold with the new farm. Brainstorming was conducted around the broad issue of offering Bob advice on the processes of selling raw wool which was a strategy to ensure participants felt comfortable with the topic. Once participants had the opportunity to discuss their experiences, the discussion was then narrowed to the issue of forward contracts. The scenarios were presented as follows:

1. What advice would you give Bob with respect to selling his wool?
2. What other ways are there to sell wool in Australia
3. As far as you are concerned, what are the advantages to Bob (by selling using forward contract)?
4. As far as you are concerned, what are the disadvantages to Bob (by selling using forward contract)?
5. Given what you have heard so far, how would Bob know how much better off he is?

Upon the completion of each scenario, participants were asked to type their ideas into their anonymous “play space” and press F9 on their individual keyboards to record their input. Participants who did not feel confident in typing their thoughts were provided with assistance from the research team. Probing of ideas was provided by all members of the research team. This technology proved to work efficiently except in cases where participants did not feel confident to asking for assistance to type. Each focus group ran for about two and a half hours with participants being provided with a copy of the raw data collected in the form of a print-out from the MGSS.

Data analysis

A range of techniques are suggested by authors, such as Miles and Huberman (1994), that will assist with the challenging task of analysing qualitative data. Given the objectives of the research and its exploratory, rather than confirmatory, nature, content analysis was the preferred technique for analysing the raw data collected from the focus groups. Content analysis involves the examination of data in a systematic and replicable fashion (Riffe, Lacy and Fico, 1998; Wilkinson, 2004). It requires transcripts of raw, qualitative data to be systematically trawled for recurrent themes. Each theme

is then counted throughout the transcripts for its replication within the data thus introducing a quantitative element to the research.

Analysis of the raw data electronically generated from the focus groups was undertaken as a two-phase process that combined inductive and deductive approaches to categorise factors and variables, as described by Quaddus and Xu (2005).

The inductive phase of the content analysis was undertaken as follows:

1. Transfer raw data from AnyZing 5.0 to ATLAS.ti 5.0 software (<http://www.atlasti.com/index.php>).
2. Scan printed transcripts of the raw data for recurring themes to produce labels/categories.
3. Enter the labels/categories into ATLAS.ti for generation of flow charts to show the relationship of factors, variables and their links for each focus group.

The deductive phase of the content analysis aimed to integrate the findings for the individual focus groups. This phase produced a combined model of factors and variables uncovered in the focus groups and also took into account elements of the firmly-established theories of Reasoned Action, Planned Behaviour and Diffusion of Innovations. This was carried out as follows:

1. Undertake a review of the literature on the Theory of Reasoned Action, Theory of Planned Behaviour and Diffusion of Innovation paying particular attention to agribusiness-related research.
2. Revisit the factors, variables and their links established from the focus groups in Phase 1.
3. Combine all the factors and variables of the four focus groups and develop an integrated flow chart to show the relationship of factors, variables and their links for all focus groups.
4. Add in elements from similar previous studies, as identified in the literature.
5. Develop a combined model of factors and behaviours that will explain wool producers' intention to adopt the use of forward contracts to sell their raw wool.

Table 1: Factors and variable of forward contract adoption

(N = Northampton, K = Kojonup, M = Merredin, E = Esperance)

Issues	Sub-issues	N	K	M	E	Frequency
Methods of selling wool currently						
Auction	Is the dominant system & a good place to start	✓	✓	✓		3
Electronic selling	WoolTrade, e-wool	✓				1
Hedge			✓	✓		2
Find buyers			✓			1
Find value of wool			✓			1
Wool quality & wool type			✓	✓	✓	3
Understand customer requirements			✓			1
Dollar movement/value			✓			1
Cost of production			✓		✓	2
Forward sell				✓	✓	2
On-farm diversity			✓		✓	2
Fair deal = costs + margin			✓			1
Find a broker	Such as Elders, Landmark	✓	✓	✓	✓	4
Find an agent/private buyer	Such as Primaries, West Coast Wools	✓		✓	✓	3
Appoint a portfolio manager	From Elders or Landmark			✓		1
Sell over extended period of time				✓	✓	2
Industry research					✓	1
AWTA testing				✓	✓	2
Set reserve price				✓		1
Alternative systems of selling wool						
Direct to mill		✓	✓		✓	3
Fibre Direct			✓			1
Futures		✓	✓	✓		3
Process & sell			✓			1
Advantages of forward contracts						
An idea for profit			✓			1
Be satisfied with the price you get			✓			1
Provides a known & secure income			✓	✓	✓	3
Good for upward market			✓		✓	2
Helps with budgeting			✓	✓	T	3
Need a stable buyer			✓			1
Forward contract is a regular practice				✓	✓	2
Split between auction & forward contract to minimise price risk				✓	✓	2
Risk management	Spreading contracts over time	✓		✓	✓	3
Ability to set/negotiate price					✓	1
No guess work after sale is made					✓	1
Means of getting a premium price					✓	1
Ability to assess wool					✓	1
Peace of mind		✓		✓		2
Positive experience	Fast, painless, simple			✓		1
Provides ready cash-flow		✓				1

Table 1 (continued): Factors and variable of forward contract adoption

(N = Northampton, K = Kojonup, M = Merredin, E = Esperance)

Disadvantages of forward contracts						
Lack of volatility			✓		✓	2
Unprofitable			✓			1
Cost of insurance policy			✓			1
Results in higher cost of production			✓			1
Uncertainty – insecure buyer			✓	✓		2
Unable to secure a profitable price		✓	✓			2
Uncertainty – not meeting delivery schedule		✓	✓	✓	✓	4
Creates family problems			✓		✓	2
Uncertainty – missing higher prices		✓	✓		✓	3
Uncertainties – weather, supply, demand					✓	1
No economic gain					✓	1
Uncertainty of market conditions		✓			✓	2
Dominance of auction system					✓	1
Dominance of auction price			✓	✓	✓	3
Not a common practice					✓	1
Paper-work					✓	1
Fine print		✓				1
Unfamiliarity		✓				1
No one pushing it		✓				1
Contract rules		✓				1
Obligation to contract more wool than desired				✓		1
Uncertainty of wool value				✓		1
Only available for specific grades				✓		1
Uncertainty – requirement for fast cash				✓		1
It's about individual judgement				✓		1
Advantages are not clear					✓	1
Other issues						
Benchmark with other farmers	Is anybody getting a better price?		✓			1
Take a strategic, supply chain view			✓			1
Experience & confidence	Market is vital, wool producing experience is vital, start with auction system before trying anything else.	✓		✓	✓	3
Slow market					✓	1
Competitive market					✓	1
Low demand for wool					✓	1
Long supply chain	No feedback on quality				✓	1
Wool is a by-product of meat production		✓				1
Consider your tax/financial position		✓				1
Proactive		✓				1
Risk management vs making money				✓		1
Price settlement issues				✓		1
Individual judgement				✓		1
Entirely different to futures				✓		1

Results

Factors and variables of forward contract adoption

Table 1 shows the complete list of themes of wool producers' opinions of selling wool in Australia; as generated from the focus groups using content analysis (also see schematic of Table 1 in Figure 4a and 4b). The scenario titles used in the focus groups are used as headings in the table and the outcomes of the discussion are shown below each heading. The table also shows sub-issues or points of clarification that were raised, but most importantly, it shows from which location the issues arose and their frequency, or replication, of discussion. Methods of selling wool and the processes involved are first illustrated which is then followed by the factors and variables associated with the adoption of selling raw wool by forward contract. Note that factors and variables are taken straight from common themes from the focus groups. Despite an extensive search of the literature, no tested framework could be found for categorising or labelling the issues found here.

It can be seen in Table 1 that a combination of selling methods and selling behaviours were identified when participants were asked to discuss the ways they currently sell wool and what advice they would give to their new neighbour. The dominant method suggested was selling wool by auction with this being suggested by three of the focus groups. Participants of all focus groups suggested finding either a broker, agent or private buyer to facilitate the process of selling wool at auction. Other dominant suggestions were being able to sell directly to a mill or selling wool on the futures market. Other selling methods were listed as electronic selling (such as e-wool™ or Wooltrade Australia Pty Ltd), hedging, forward selling, Fibre Direct (selling directly to the spinner) or process and then selling. It should be noted that forward contracts were only mentioned as a selling method at half of the focus groups.

Most of the discussion of advising Bob how to selling his wool revolved around the processes and behaviours associated with selling wool. The dominant issue was finding a broker or agent who can offer a range of selling methods. Other behaviours involved the knowledge required to sell wool, such as understanding the value of the wool to be sold, setting of a reserve price, understanding the wool quality and quantity for sale, understanding the cost of production, getting the wool quality tested, conducting industry research, understanding the movement of the Australian dollar and finding of a buyer.

Of the sixteen advantages of selling wool by forward contract, the most frequently raised issues were that they provide a secure income, they help with budgeting and they are a good risk management tool. These were underpinned by the fact that forward contracts were said to provide an opportunity to diversify the method of selling wool and that they provide peace of mind.

The list of disadvantages was far more extensive than the advantages with twenty-six factors discussed. Only one theme was discussed by participants of all focus groups – the uncertainty of not be able meet the delivery schedule. Other dominant issues revolved around the uncertainty associated with taking out a forward contract. Participants discussed the concept of missing out on a

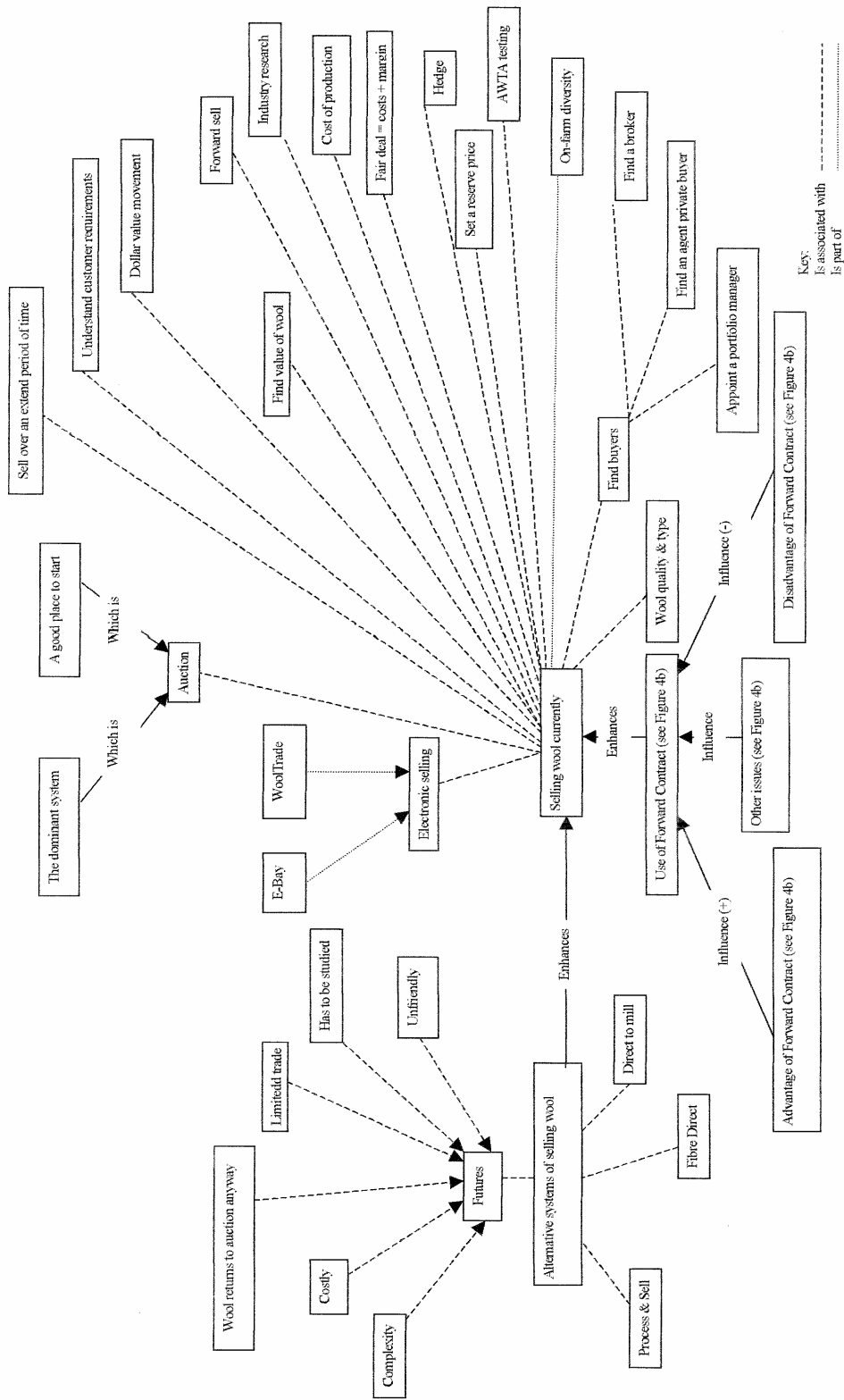


Figure 4a: Factors explaining the intention of Australian wool producers to adopt the use of forward contracts to sell raw wool

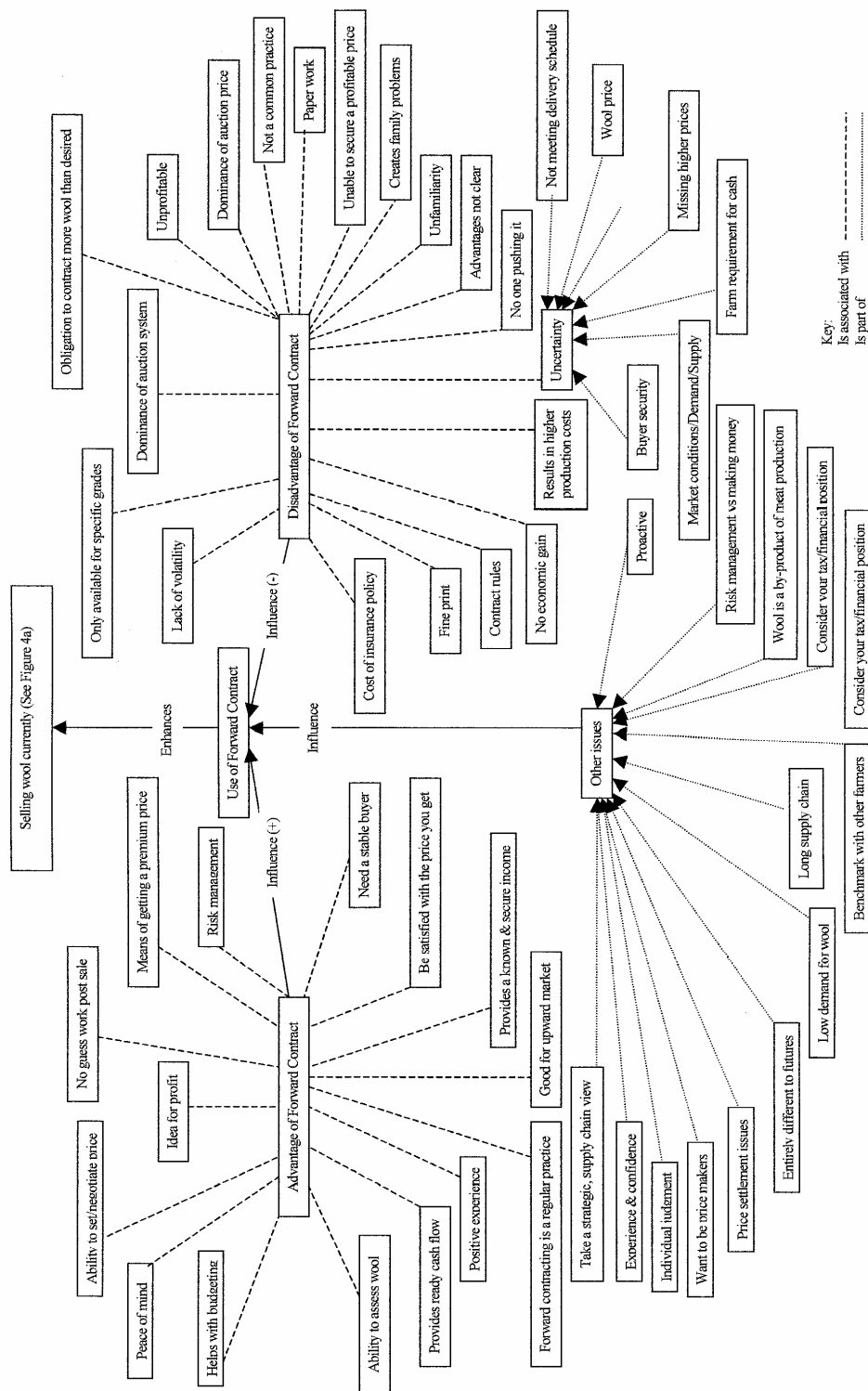


Figure 4b: Factors explaining the intention of Australian wool producers to adopt the use of forward contracts to sell raw wool (continued)

rise in the market price of wool, the benefits of price volatility that is offered by the auction system (capturing a spike in the market price), the difficulty and complexity of negotiating a profitable price with a broker or buyer, the uncertainty of market conditions and the uncertainty of selling wool forward to an insecure buyer. Other issues that were discussed in terms of disadvantages were the perceived amount of paper work, rules and fine print associated with forward contracts, the perception that forward contracts are only available for certain grades and the fear of being obliged to forward sell more wool than desired.

The over-arching issue that was borne from the discussion of the disadvantage of forward contracts regarded the dominance of the auction system. Aside from the production risks and price uncertainties, most of the comments made were related to the dominance of the auction system in the sale of raw wool. Participants from the Merredin, Kojonup and Esperance focus groups said out-right that daily auction prices provided the benchmark for their knowledge of the current wool price. Participants believed that people are unfamiliar with the use of forward contracts because no commercial agribusinesses seem to be pushing their use. They said that using forward contracts creates family problems because it is not the "normal" method of selling wool. Participants were also adamant that an auction system will continue to exist. They believe that all wool sold on forward contract or on the futures market is eventually sold by auction; as are the off-grades of wool that are not able to be sold by forward contract.

Other issues that were raised from the discussion of selling wool by forward contract revolved around the current state of the wool industry and also issues internal to the farm business. Experience and confidence were discussed during three of the focus groups. It was agreed that using forward contracts was about using individual judgement and required having experience with your sheep and wool as well as having confidence in negotiating a suitable price. It was also said that the slow and competitive wool market is an inhibiting factor to growers not using forward contracts, as well as the long supply chain and the low global demand for wool.

In terms of the discussion of issues from each focus group, thirty-six issues were raised from the Esperance group, thirty-two from the Kojonup group, thirty from the Merredin group and nineteen from the Northampton group. In all cases, there were far more disadvantages raised of using forward contracts than advantages (thirty-six to twenty-five) with the Esperance group stating the most advantages and disadvantages (nine to twelve); the group from Merredin came up with equal advantages and disadvantages (seven).

In summary, some sixty-one advantages and disadvantages of selling wool by forward contract were raised. Seventeen "other" issues were raised however these were principally about the current state of the wool industry and how it affects producers' decisions to take out forward contracts. Interestingly, no comments were raised about the differences in selling costs between the various selling methods. Content analysis of the raw data revealed a wide range of issues that influence the use of forward contracts however the predominant factors and variables were found to be: pricing, complexity, business process improvement, dominance of the auction system and

production risks.

Discussions and research implications

Casual links among the factors

Content analysis of the raw data from the focus groups revealed information that it could be combined with the concepts used in TPB and Diffusion of Innovations to construct a behavioural model on the intention of Australian wool producers to adopt forward contracts to sell their raw wool. Analysis also showed that modifications need to be made to these traditional frameworks to adequately capture all the dimensions of farm-level decision making.

Such modifications required a search for a reliable and valid theoretical model to accommodate the specific nature of this research. A literature search

Table 2: Incorporation of raw variables into Theory of Planned Behaviour and Diffusion of Innovations independent variables.

TPB/diffusion/Xu & Quaddus independent variable	Factors and variables from focus groups
Perceived usefulness of using forward contracts	
Relative advantage	Provides a known & secure income
	Helps with budgeting
	Risk management
	Ability to set/negotiate price
	No guess work after sale is made
	Means of getting a premium price
	Ability to assess wool
	Peace of mind
	Positive experience
	Provides ready cash-flow
	Split clip between auction & forward contract
Compatibility	Obligation to contract more wool than desired
Complexity	Paper-work
	Fine print
	Unfamiliarity
	Contract rules
Application	Only available for specific grades
	Unfamiliarity
	Risk management vs making money
Risk	Uncertainty of wool value
	Uncertainty – missing higher prices
	Uncertainties – weather, supply, demand
	No economic gain
	Uncertainty of market conditions
	Uncertainty – insecure buyer
	Uncertainty – not meeting delivery schedule
	Lack of volatility
	Unable to secure a profitable price
Perceived behavioural control surrounding use of forward contracts	
Self efficacy	Experience & confidence
Support	No one pushing it
Subjective norms as a way of using forward contracts	
	Dominance of auction system
	Dominance of auction price
	Creates family problems
	Benchmark with other farmers

found a diffusion model by Xu and Quaddus (2005) that used attitudinal variables as antecedents to a combination of traditional TPB and diffusion constructs. With attitudinal variables as antecedents, factors like perceived usefulness, subjective norms and perceived behavioural control have shifted from being exogenous to endogenous.

Table 2 shows how factors and variables from the focus groups have been grouped to loosely align with the independent variables of the TPB/diffusion/Xu and Quaddus frameworks. Figure 5 diagrammatically shows this causal relationship with arrows indicating the directions of dependence between variables.

In addition to these variables, factors were also identified from the focus groups that are thought to influence the three independent variables of this research's theoretical frameworks. Research by Beedell and Rehman (1999), Tutkun and Lehmann (2006), Tutkun, Lehmann and Schmidt (2006), Dierks and Hanf (2006) and Mazzocchi, Lobb and Traill (2006) shows the successful application of factors external to the TPB model in the agribusiness research domain. In terms of the present research on the adoption of forward contracts for selling raw wool, content analysis of the focus group data showed that factors external and internal to the farm business effect farmers' decision on whether or not to take a forward contract.

While the aforementioned authors have shown that it is possible to extend the traditional the TPB model, this research only uses parts of the TPB that have been identified to be suitable for answering the research question. Indeed the diffusion model by Xu and Quaddus (2005) provides a more accurate template for what is trying to be achieved herein. Figure 5 shows an adaptation of the discussed adoption models.

In addition to the use of information from the focus groups for the development of a behavioural model, a review of the literature provided justification for inclusion of variables in this research's model. Table 3 outlines publications that have shown the successful application of specific variables used in this research to test farmer behaviour and adoption of various technologies.

The behavioural model

Figure 5 presents the behavioural model developed from this research. It explains the intentions of wool producers to sell their wool by forward contract. The model has been developed from a comprehensive review of the literature on the TPB and Diffusion of Innovations. Content analysis from four focus groups with Western Australian farmers revealed that only select elements of these robust theories are appropriate for this research as they failed to capture all the dimensions in farm-level decision making. For this reason, literature was reviewed again to find a model that would address this problem. Xu and Quaddus' (2005) theory on the diffusion of knowledge management systems provided a more suitable framework but more importantly showed that constructs from various behavioural theories can be united and expanded to develop a new valid and reliable theory. It can therefore be said that the model presented in Figure 5 is unique as it draws

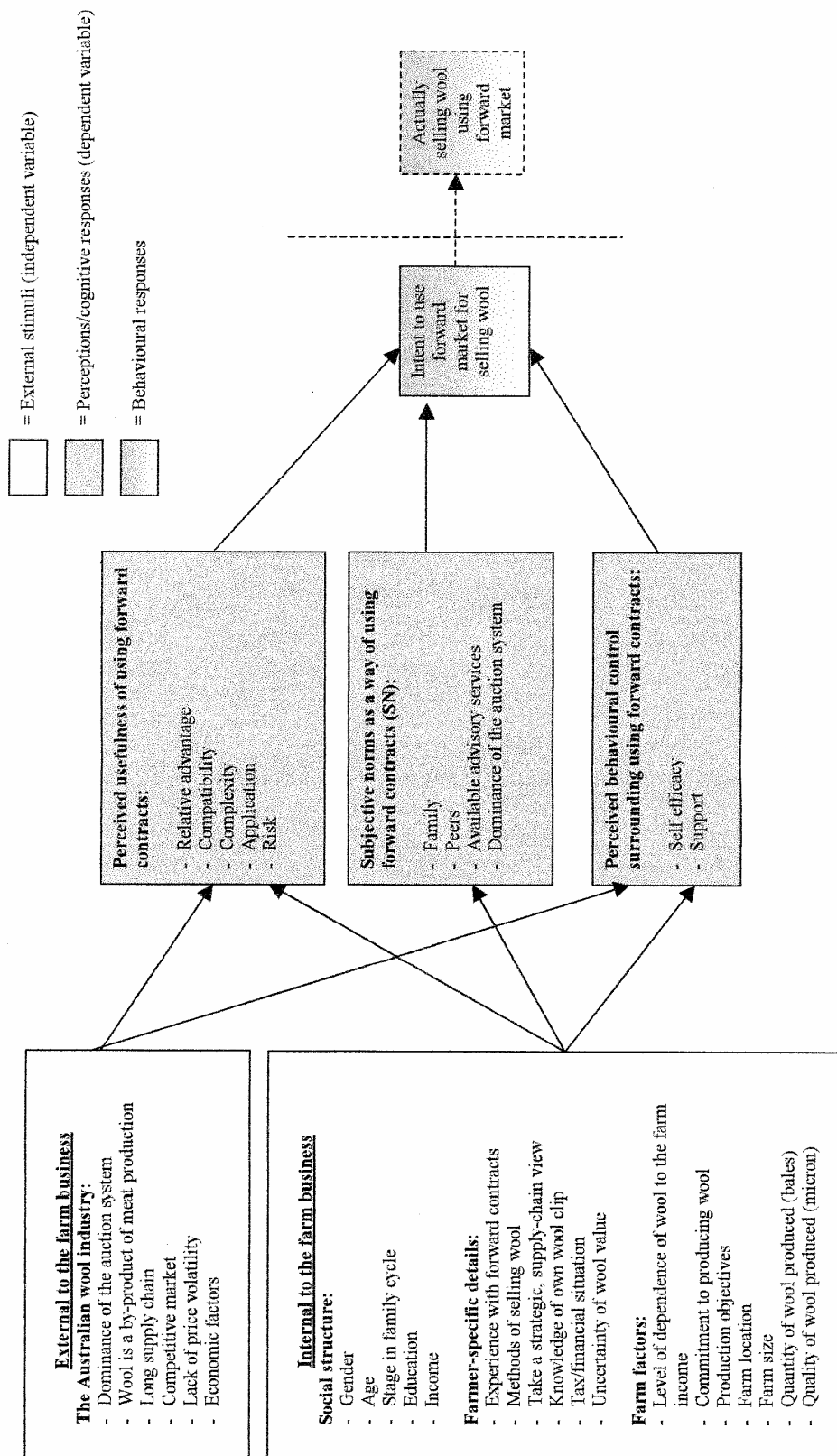


Figure 5: Factors explaining the intention of Australian wool producers to adopt the use of forward contracts to sell raw wool

Table 3: Source references for justification of factors and variables within the research model.

Item	Author	Date
External to the farm business	Willcock <i>et al</i>	1999b
All items taken from focus group information		
Internal to the farm business		
<i>Social structure</i>	Fliegel	1993
Gender	Fliegel	1993
Age	Fliegel Ervin & Ervin Harper <i>et al</i>	1993 1982 1990
Stage in family cycle	Rogers Carlson & Dillman Wilkening & Guerrero Wilkening & Bharadwaj Gasson & Errington	1995 1983 1969 1968 1993
Education	Gasson Fliegel Ervin & Ervin Harper <i>et al</i> Rahm & Huffman Makus <i>et al</i>	1998 1993 1982 1990 1984 1990
Income	Fliegel Beedell & Rehman Rahm & Huffman	1993 1999/00 1984
<i>Farmer-specific details</i>	Willcock <i>et al</i>	1999b
All items taken from focus group information		
<i>Farm factors</i>	Willcock <i>et al</i>	1999
Farm location	Fliegel Austin <i>et al</i>	1993 2001a&b
Farm size	Beedell & Rehman Makus <i>et al</i> Musser <i>et al</i> Vergara <i>et al</i>	1999/00 1990 1996 2004
Production objectives	Focus groups	
Quality & quantity of wool produced	Focus groups	
Level of dependence of wool to the farm income	McLeay & Zwart	1998
Commitment to producing wool	Focus groups	
Perceived usefulness		
Relative advantage	Rogers Tan & Teo Fliegel & Kivlin	1995 2000 1962
Compatibility	Rogers Tan & Teo Fliegel & Kivlin	1995 2000 1962
Complexity	Rogers Tan & Teo	1995 2000
Risk	Rogers Tan & Teo Willcock <i>et al</i>	1995 2000 1999b
Application (combination of trialability & observability)	Rogers Tan & Teo	1995 2000
Perceived behavioural control		
Self-efficacy	Ajzen Rogers	1991 1995
Support	Tan & Teo	2000
Subjective norms	Focus groups	
Advisory services & opinions of peers, family & public	Fliegel Beedell & Rehman Makus <i>et al</i>	1993 1999/00 1990
Intention	Ajzen Tan & Teo Christian <i>et al</i> Marcil <i>et al</i> Tutkun & Lehmann Tutkun <i>et al</i>	1991 2000 2002 2001 2006 2006

together new and traditional constructs to answer our research question.

There are no formal hypotheses proposed herein however quantitative research methodology can now be used to test the model in its application to real-world wool commerce. For example, work by Barclay, Higgins and Thompson (1995), Tutkun and Lehmann (2006) and Tutkun, Lehmann and Schmidt (2006) suggests that the causal modelling approach of structural equation modelling can be used to test the model. While Figure 5 can be used as the research model for the aforementioned proposed research, further exploratory research will need to be conducted to formulate formal hypotheses.

This research will be a new addition to the TPB literature on the behavioural aspects of agribusiness systems and will add to the already vast research on the adoption of agricultural innovations thus adding strength to the tradition of rural sociology in diffusion research.

Agribusiness implications

It has been demonstrated that an anomaly exists between the risk-averse nature of farmers' decision-making behaviour and the increasing amount of risk associated with selling wool at auction; the method which dominated as the most preferred selling method of raw wool in Australia. Figure 5 will be useful to the agribusiness and wool commerce industries in addressing this anomaly so that organisational decisions regarding the future of the wool industry (WoolProducers call for grower ideas, 2004; How will we market our wool?, 2004; Peacock, 2004) and the auction system (Cuming, 2005; Woods *et al*, 2005; Weakness in wool auction: Flugge, 2004) can be made with the opinions of producers in mind; opinions gathered by the structured, replicable and time-tested models of TPB and diffusion. The major benefits will be to advocates of selling wool by forward contract; such as wool brokers and merchants who are keen to make forward contracts with producers in order to stabilise supply to spinners (for an example see Harris, 2006). Such brokers and merchants can use this information to better understand the behavioural factors limiting the use of forward contracts by Australian producers to hopefully increase their adoption rate and thus assist producers to better manage their ever-increasing exposure to price risk.

Summary and Conclusions

This paper presents the background, method, results and discussion of research undertaken to determine the factors and variables associated with the intention to adopt the use of forward contract to sell raw wool by Western Australian farmers. Four focus groups were conducted in regional Western Australia with a total of twenty-six wool producers participating, not all had experience selling wool by forward contract. Curtin University's MGSS was used to capture data, these data were then transferred into ATLAS.ti for content analysis to be undertaken. A schematic of the results was combined with relevant literature related to the TPB and the theory of Diffusion of Innovations to construct a behavioural model that explains farmers' intention to adopt forward contracts to sell their raw wool.

The focus groups revealed five major variables that affect the use of forward contracts: pricing, complexity, business process improvement, dominance of the auction system and production risks. It was also found that some elements of the TPB (perceived usefulness and subjective norms) and the Diffusion of Innovations theory (relative advantage, compatibility, complexity, application, risk and self-efficacy) fitted with the findings as endogenous variables. Most importantly, however, the TPB's "attitude" construct was found to remain as an exogenous variable in the form of influences internal and external to the farm business.

This research contributes to theory and practical agribusiness. Contributions to theory are in the forms of adding a new dimension to the body of knowledge that already exists on TPB and strengthening the rural sociology tradition of Diffusion of Innovations. In terms of agribusiness, this work could contribute to industry decision-making on the future of the nation's auction system and its extension efforts on forward contracting.

The immediate goal is to study the combined model further by employing structural equation modelling to test its validity and reliability. This quantitative stage of the research will involve the development and testing of formal hypotheses on the behavioural model.

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REFEREED PAPER

**ESTIMATING THE UNIT COSTS OF PRODUCING
OILSEED RAPE IN ENGLAND***L.J. Hubbard, P.J. Dawson and C.R. Scott¹*

Average cost curves, which show how unit cost varies with output, are estimated for oilseed rape production in England for 2003/04 using farm survey data. Results show that economies of size are all but exhausted at 70-80 tonnes or around 22 hectares; thereafter costs remain almost constant. The best managers have average costs £25-35/tonne lower than the worst, and there are also significant regional differences.

Key words: average costs, cost curves, oilseed rape, economies of size

Introduction

The 2003/04 growing season was a poor one for oilseed rape. Although temperatures and sunshine hours were close to their annual averages, rainfall was below average during the autumn sowing period, and above average during harvest. In the latest report on the economics of oilseed rape production commissioned by Defra (Newcastle University 2006), net returns across 200 surveyed farms averaged only £75/ha. for the winter sown crop, compared to £476/ha. recorded in the previous report of 1996 (Askham Bryan 1996). The much lower net returns in 2004 were due to lower yields, lower output prices and lower area payments; production costs were similar to those in 1996. But how do the costs of producing oilseed rape vary as the level of output on a farm varies? This is the central question addressed in this paper.

Baker, *et al.* (1991) found evidence of correlation between net margin and size of enterprise in oilseed rape production, due to a combination of lower yields on smaller farms and lower costs per hectare on larger farms. More recently, with respect to economies of scale, it was concluded that "... there is no relationship between size of farm or enterprise and levels of output or margins as far as oilseed rape is concerned [although] ... there is scope here for further research and analysis" (Askham Bryan 1996, p.34). In this paper, we take up that challenge and explore economies of size in oilseed rape production². We use an econometrics approach to estimate a long-run average cost (LAC) curve, which relates average (unit) cost of production per tonne to size of enterprise. This approach is based on similar research in the England and Wales dairy sector (Dawson and Hubbard 1987; Hubbard 1993; and Burton, *et al.* 1993).

Economic theory postulates that the LAC curve shows the minimum unit cost of producing every level of output³. Traditionally, the curve is assumed to be U-shaped, reflecting economies of size (falling unit costs) up to a certain level of output and then diseconomies of size (rising unit costs) at higher levels of output. However, empirical studies often fail to detect diseconomies of size even at very high output levels. Accordingly, an L-shaped LAC curve,

1. The authors are grateful to the editor and two anonymous referees for helpful comments on a previous draft.

2. Economies of scale is a special case of economies of size: the former relates to the effect on output of an equi-proportional change in all inputs, whereas the latter is less restrictive and relates to variation in some or all inputs.

3. Input prices and technology are assumed to be fixed and given.

where unit costs initially fall as output increases but thereafter remain constant, is often postulated. Indeed, this was a general finding of the dairy enterprise research cited above. The output level where economies of size are realised is important for farm managers because it indicates the minimum level of optimal capacity.

Estimation and Data

We seek to find the curve that best represents the relationship between average cost and level of output. This could be done by relating average cost to *actual* output, but it is more appropriate to relate average cost to *planned* output, on the basis that costs are more likely to reflect what the farmer expects output to be (Dawson and Hubbard 1987). Accordingly, a pragmatic two-step procedure is adopted. In the first step, the farmer's planned output is determined by estimating a production function based on the farmer's actual use of inputs (area, labour, fertiliser, etc.). In the second step, we estimate the LAC curve where average cost is calculated as total cost divided by planned output, and this is then related to the level of planned output.

The data are taken from the special study on the economics of oilseed rape production in 2003/04, undertaken for Defra (Newcastle University 2006). The total sample is 184 farms growing the winter sown crop and summary statistics are presented in Table 1⁴. The average area sown was 57 ha. with an output of 185 tonnes, giving a yield of 3.2 tonnes/ha. The average cost across the sample was £176/tonne, but minimum and maximum values in Table 1 indicate wide variation between farms from £70/tonne to £600/tonne⁵.

To provide a further insight, Figure 1 shows the scatter plots of variable, fixed and total costs/ha. against (actual) yield/ha. Variable costs are those of seed, fertiliser and sprays; fixed costs are those of labour, machinery, buildings and land, including rent; and total cost is their sum. The scatter of fixed costs and yield (tonnes/ha.) shows that, in general, fixed costs/ha. remain relatively constant. This should not be surprising since machinery is a key component of fixed costs and while machinery varies with the size of the farm, it has little observed relationship with yield. Perhaps more surprising is the scatter of variable costs/ha. and yield which shows a weakly positive, but statistically insignificant relationship.

Figure 2 shows the scatter plot of actual average cost (i.e., the total cost of delivering the crop to market divided by actual output of oilseed rape) against the level of actual output. This indicates that average costs on some smaller enterprises are higher, but diseconomies of size (i.e., rising average costs) are not obviously discernible at higher levels of output. This lends support to the idea of an L-shaped, rather than U-shaped, LAC curve. However, Dawson and Hubbard (1987) point out the danger of trying to infer the shape of the LAC curve from a two-dimensional scatter whilst ignoring the crucial influence of management. Greater managerial ability allows a farmer to produce any given output at a lower cost and each point on the scatter is associated with a given level of managerial ability. Management is often omitted from estimation

4. The number of farmers growing the spring sown crop was much smaller and did not present a large enough sample for econometric analysis. Also, a small number of farms had total or partial crop failure and were omitted from the analysis.

5. Some costs are imputed and may mask differences between farms.

Table 1. Descriptive Statistics

	Mean	Minimum	Maximum
<i>Number of farms = 184</i>			
Total Cost (£)	28,997	2,646	129,567
Average Cost (£/tonne)	176	70	601
Output (tonnes)	185	9	856
Area (ha.)	57	6	284
Labour Costs (£)	1,839	13	13,459
Machinery Costs (£)	6,282	10	28,098
Seed Costs (£)	1,695	20	10,710
Fertiliser Costs (£)	5,355	548	25,272
Sprays Costs (£)	5,456	84	39,312
Margin / Materials (£)	14,441	-1,959	86,971
<i>East Region: Number of farms = 100</i>			
Total Cost (£)	34,333	2,646	129,567
Average Cost (£/tonne)	187	70	559
Output (tonnes)	211	15	856
Area (ha.)	67	6	284
Labour Costs (£)	2,152	13	13,459
Machinery Costs (£)	7,870	10	28,098
Seed Costs (£)	1,959	20	10,710
Fertiliser Costs (£)	5,973	548	25,272
Sprays Costs (£)	6,422	84	39,312
Margin / Materials (£)	16,511	-1,959	86,971
<i>West Region: Number of farms = 44</i>			
Total Cost (£)	20,088	3,899	59,821
Average Cost (£/tonne)	190	95	601
Output (tonnes)	119	9	428
Area (ha.)	40	7	131
Labour Costs (£)	1,341	134	5,459
Machinery Costs (£)	3,785	227	15,597
Seed Costs (£)	1,150	106	2,864
Fertiliser Costs (£)	4,023	638	11,679
Sprays Costs (£)	3,994	523	13,283
Margin / Materials (£)	8,595	-1,693	46,413
<i>North Region: Number of farms = 40</i>			
Total Cost (£)	25,459	3,627	97,382
Average Cost (£/tonne)	134	88	227
Output (tonnes)	192	16	684
Area (ha.)	51	8	195
Labour Costs (£)	1,608	68	4,441
Machinery Costs (£)	5,057	119	16,563
Seed Costs (£)	1,637	116	7,406
Fertiliser Costs (£)	5,274	663	21,455
Sprays Costs (£)	4,648	415	21,921
Margin / Materials (£)	15,697	228	64,039

Source: Newcastle University (2006).

Figure 1. Variable, fixed and total costs.

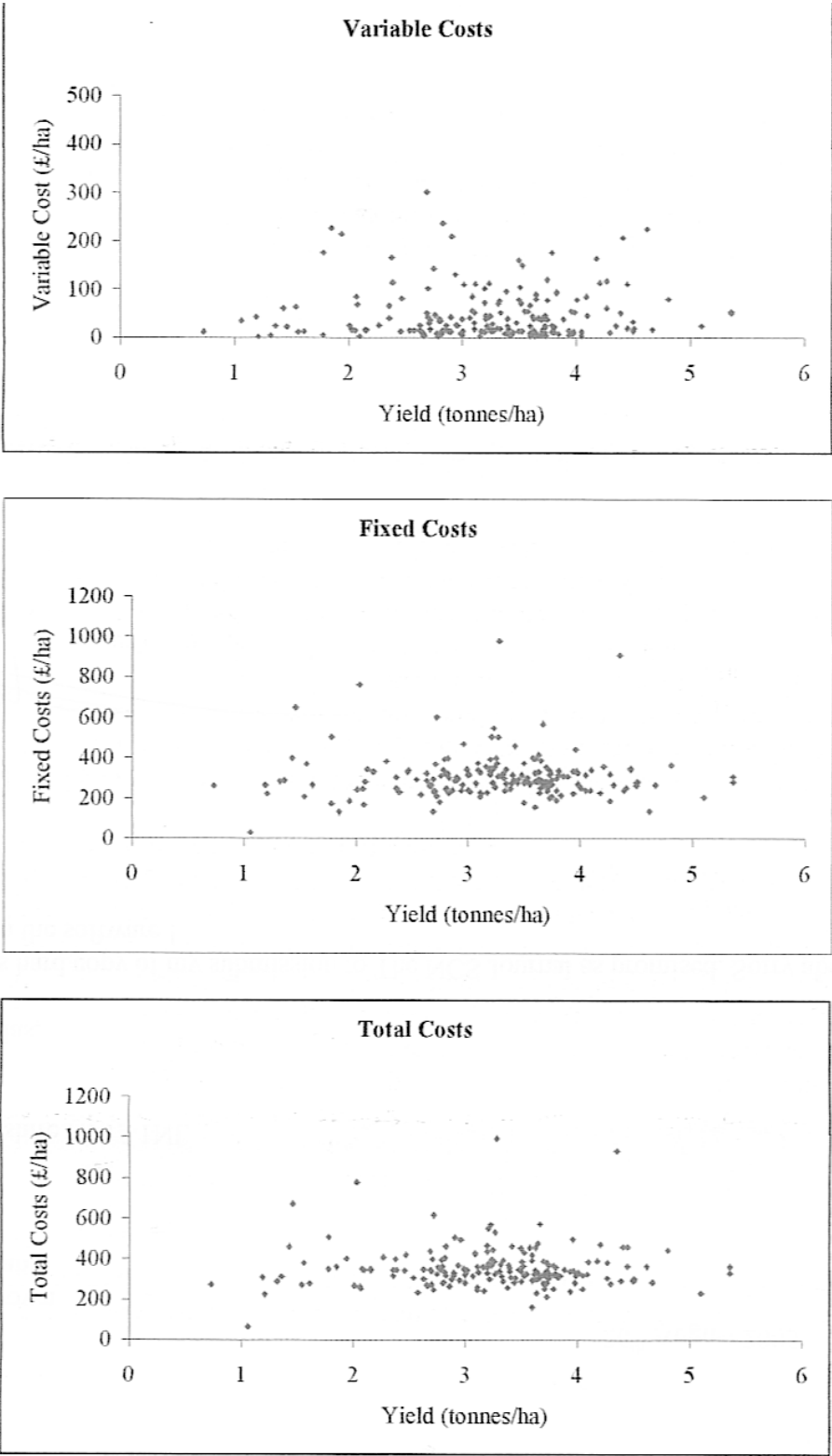


Figure 2. Actual Average costs.

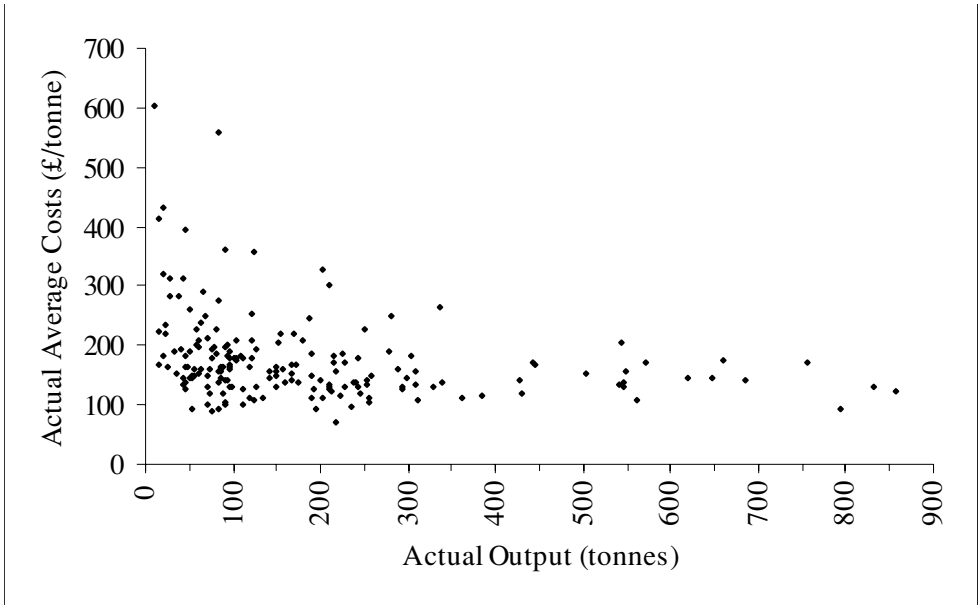
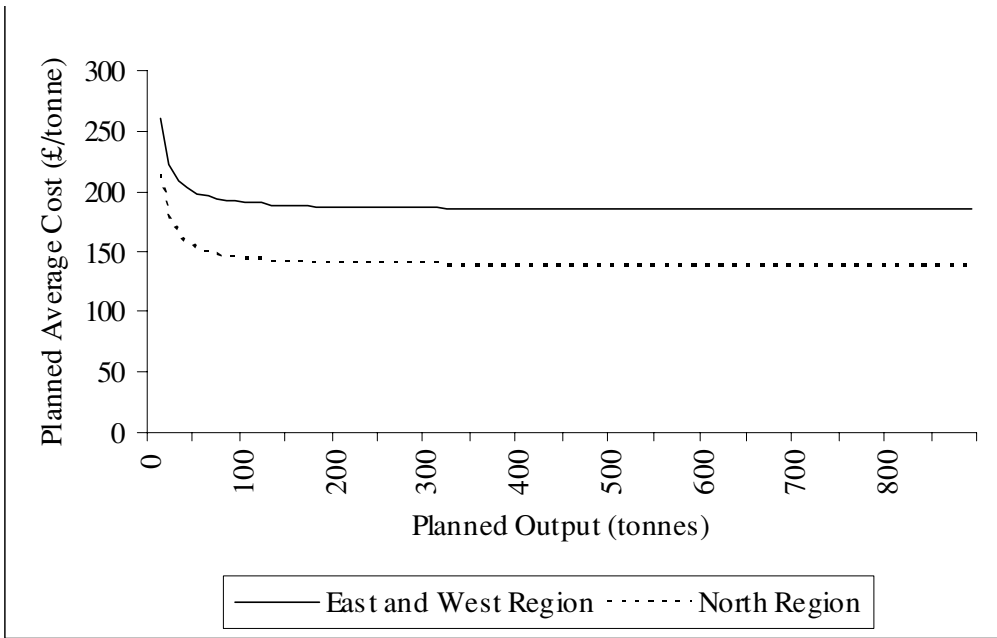


Figure 3. Long run average cost curves.



because it is unobservable and therefore not easily measured, but this results in biased estimates. We include management in our estimated LAC curve and use margin-over-materials as a proxy measure.

Preliminary analysis of the data also reveals regional differences and therefore we have divided the sample into sub-samples using the European Union super-regions for England – North, East and West. Most farms (100) are in the East, but the samples for the North (40) and the West (44) are of sufficient size for further analysis. Summary statistics for the three regional sub-samples are also shown in Table 1. Average cost in the East (£187/tonne) and West (£190/tonne) are similar, but that for the North is considerably less (£134/tonne). This is due to yield differences: in the East and West, average yield is around 3 tonnes/ha. while in the North it is 3.8 tonnes/ha. Total costs *per hectare* are similar across all three regions at around £500.

Results

Given the regional variation in the data, we apply our two-step estimation procedure separately to each of the three sub-samples. In the first step, a production function is estimated using the actual input data for each farm. From this, we obtain an estimate of planned output which is used to estimate the LAC curve in the second step. This is done using a reciprocal function, as in Hubbard (1993), which allows for continuously falling average cost, in keeping with an L-shaped curve. Initially, cost functions were estimated separately for each of the three regions. However, we obtained improved econometric results by estimating a single cost function with dummy variables to distinguish between the regions.

The first step of the estimation procedure is to estimate a (Cobb-Douglas) production function for each region and, while not of primary interest, they do provide some insights⁶. Area is the dominant input, as expected, with area elasticities implying that a 1% increase in area increases output in the range 0.65-0.91%. The estimated production function for the West region shows that the input elasticities for labour and seed are negative which implies that, on average, additional use of these inputs reduces output, i.e., too much labour and seed are currently used. Similarly, the input elasticity for machinery in the East region is negative. Accordingly, we omit these inputs from the production functions and our preferred results are presented in the Appendix.

In estimating the LAC function with dummy variables to distinguish between regions, statistical testing revealed no significant difference between the East and the West, and therefore these two regions are treated as one. We also examine the impact on average costs of contract use since this is an important feature of oilseed rape production in England. Seven types of contract are used: 25 farms employ contractors for cultivation, 42 for spraying, 43 for swathing, 21 for harvesting, four for haulage, 14 for drying, and 37 for storage. Contract use is included in the LAC function by dummy variables, one for each contract type; for example, the dummy for cultivation takes a

6. While the Cobb-Douglas production function is restrictive, $R^2=0.99$ for each region, and more general functions made little difference to estimates of planned output.

value of unity if the farm employs a contractor for cultivation and zero if not.

Our preferred estimated function is shown in Table 2. The statistical properties of this function are satisfactory: the key coefficients relating to planned output and management are significant and the R^2 -value, which implies that 34% of the variation in planned average cost is explained by variations in planned output and management (and the dummy variables for region and contract use), is adequate given the use of cross section data⁷. The estimate of the management coefficient is negative, which implies that better managers are able to produce at lower average costs. The value of the estimated coefficient for the combined East and West regions implies that, on average, costs there are £41/tonne higher than in the North.

Table 2. Estimated LAC Function.

Dependent Variable: Total Cost/Planned Output.

Constant	142.2	(24.47)
1 / Planned Output	773.4	(2.62)
Management	-0.0004	(2.66)
Dummy for East and West regions	40.6	(8.68)
Dummy for cultivation contract	-6.6	(1.17)
Dummy for spraying contract	-3.2	(0.59)
Dummy for swathing contract	-3.3	(0.56)
Dummy for harvesting contract	-16.4	(3.54)
Dummy for haulage contract	14.4	(2.05)
Dummy for drying contract	-11.5	(1.77)
Dummy for storage contract	-13.6	(2.46)

R^2 0.34

Notes. 1. Equation estimated by robust errors.

2. t-statistics in brackets.

The estimated coefficients for contract use are expected to be negative since contracts are only entered into if costs are expected to be lower. Contracts for harvesting, drying and storage reduce costs significantly (at the 10% level) by £16/tonne, £11/tonne and £13/tonne respectively; those for cultivation, spraying and swathing also reduce costs, although not significantly; that for haulage perversely increases costs significantly by £14/tonne.

The two LAC curves, one for the East and West and one for the North, are plotted in Figure 3. They are constructed at the mean level of management, as measured by margin-over-materials, for the full sample. Observe that the fall in average cost as planned output increases becomes negligible at around 70 tonnes in the East and West regions and around 80 tonnes in the North region; these outputs are equivalent to about 22 ha. at average yields. Thus the minimum optimal area, where costs fall to their lowest level or where economies of size become fully realised, is 22 ha. and farmers who plant less than this incur substantially higher unit costs.

Given average managerial ability, the unit cost of producing oilseed rape, once the economies of size threshold has been reached, is about £145/tonne in

7. Comparison of the R^2 -value here with those in other studies is not strictly valid because functional forms differ, different independent variables are used and the enterprises under examination differ. Perhaps the best comparison is with Burton, *et al.* (1993) who report values of 0.34 and 0.45.

the North and £185/tonne in the East and West. The best managers can lower these costs to about £125/tonne in the North and £156/tonne in the East and West, whereas for the worst managers average costs rise to around £151/tonne in the North and £192/tonne in the East and West.

Discussion

Economies of size in oilseed rape production are all but exhausted at relatively low levels of output. However, diseconomies of size are not evident and once a fairly low output threshold has been reached, average costs of production remain almost constant. In the major production region of the East, and also in the West, this threshold is around 70 tonnes while in the North it is around 80 tonnes; these equate to about 22 ha. at average yields. Thus, once an output threshold of 70-80 tonnes is reached, the scope for further reductions in unit costs of production, as a result of economies of size, appears very limited. The finding that economics of size are realised at relatively low levels of production for oilseed rape is consistent with findings elsewhere for other UK crops, and recent examples include Lang and Allin (2004) for cereals and Cambridge University (2004) for sugar beet. The reasons for this however are not clear. The use of contractors by small farms may provide access to large machinery and hence economies of size, but the correlation between contracting costs and machinery costs is statistically insignificant, as indeed is that between contracting costs and oilseed rape area. Moreover, the number of small farms in our sample is not inconsiderable: 41 farms have an oilseed rape area of less than that where economies of size are realised, i.e. 22 ha. It is not the case then that there are few farms in the steeply downward-sloping section of the LAC curve.

A plausible hypothesis to explain our finding that economics of size are realised at relatively low levels of production is that smaller farms adopt conventional tillage production methods while larger farms adopt minimum tillage technology. To test this, albeit informally, we define conventional/minimum tillage with respect to cultivation operations up to and including drilling, i.e. sub-soiling, ploughing, power harrowing, rolling, drilling, etc. Suppose, somewhat arbitrarily, that conventional tillage occurs where labour and machinery costs are more than £50/ha., while minimum tillage is where such costs are less. Of the 41 farms that have an oilseed rape area of less than 22 ha., 30 adopt conventional tillage methods, and this appears to support the hypothesis. However, of the 143 farms growing more than 22 ha. of oilseed rape, only 54 use minimum tillage technology, and this tends not to support the hypothesis. From this casual evidence, we conclude that there is limited support for the hypothesis that smaller farms adopt conventional tillage methods and larger farms adopt minimum tillage technology⁸.

The level of managerial ability, measured by margin-over-materials, has an important effect on the average costs of production. Farmers with good managerial abilities incur substantially lower costs, with the best managers having an average cost of £25-35/tonne lower than the worst. A *caveat* here is the use of margin-over-materials as a proxy measure of managerial ability.

8. The dichotomy of production methods into conventional and minimum tillage raises the issue of whether the parameters in the production function are invariant across technologies, as we have implicitly assumed.

Strictly, management is a fixed input since it crucially includes the functions of co-ordinating inputs along investment lines and adjusting the production process to changes in economic conditions. It is determined by education, farming experience, etc. and therefore independent of the production process. Our proxy measure of margin-over-materials is clearly not independent of the production process since it captures not only managerial ability but also elements of land productivity, random weather effects, etc., and possibly economies of size. However, margin-over-materials is perhaps the most appropriate proxy for management, given data availability and that other measures produced inferior results.

Our results also show that oilseed rape farms in the North have lower costs of around £40/tonne than those in the East and West. We speculate three possible reasons. First, yield/ha. is on average higher in the North than elsewhere because of longer daylight. Second, there was above average rainfall during harvest which may have had a disproportionate effect on lowering yields in the East and West: all but one of the 18 farms excluded from our sample because of total or partial crop failure are located in the East and West. Third, weed control is more problematical in the East and West, with sprays used more heavily in the oilseed rotation: in the North, the average cost of sprays was £88/ha. while those in the East and West were £93 and £97/ha.

The use of contractors in oilseed rape production is widespread. Our results show that contract use for harvesting, drying and storage significantly reduces costs by £16-11/tonne, whereas that for cultivation, spraying and swathing has no significant impact on costs. Perversely, haulage contracts significantly increase costs by £14/tonne.

Finally, it should be remembered that the analysis presented here uses data for a single crop year, 2003/04. As mentioned at the outset, this was a poor year for oilseed rape and our two-step estimation procedure may produce estimates of planned output which are biased downwards, which in turn biases the LAC curve upwards. However, these biases would need to be large for them to have a substantial effect on the output or acreage where economies of size become fully realised. Nevertheless, more conclusive results may be obtained from analyses of other years, but unfortunately surveys with enterprise-specific costs are conducted only infrequently.

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Appendix: Preferred Production Function Estimates

	North Region	East Region	West Region
Constant	0.688 (0.99)	-0.926 (1.77)	-0.820 (0.64)
Area	0.907 (5.01)	0.653 (5.19)	0.730 (2.92)
Labour	0.033 (0.30)	0.05 (0.04)	-
Machinery	0.001 (0.01)	-	0.256 (0.53)
Seeds	0.029 (0.61)	0.046 (2.16)	-
Fertiliser	0.037 (0.36)	0.222 (2.91)	0.152 (1.36)
Sprays	0.028 (0.35)	0.99 (1.09)	0.171 (0.98)
R ²	0.99	0.99	0.99
Sample Size	40	100	44

Notes 1. All variables in logarithms.

2. Equation estimated by robust errors.

3. t-statistics in brackets.

WORKSHOP/SEMINAR REVIEW**REVIEW OF PAPERS PRESENTED AT A SEMINAR ON
FARM RISK MANAGEMENT ORGANISED BY THE
NORDIC ASSOCIATION OF AGRICULTURAL
SCIENTISTS, IN OSLO, NORWAY ON 14-16 JUNE 2006**

Agnar Hegrenes, Norwegian Agricultural Economics Research Institute

The Nordic Association of Agricultural Scientists, Section for Agricultural Economics and Section for Education and Extension organised a workshop/seminar on Farm Risk Management, 14-16 June 2006 in Oslo. Eighteen papers were presented, and a half day excursion was included. Most papers were given by researchers in agricultural economics but some were presented by extension officers. All in all the papers covered a wide range of aspects of farm risk management, including aquaculture. This is a brief review of those papers; all presentations (in Power Point format) can be downloaded from the seminar homepage <http://www.njf.nu/>.

There were two invited speakers at the seminar. Professor Brian Hardaker gave an overview of farm risk management; past, present and prospects, as the paper has been published in this Journal and it is not summarised here (Hardaker 2006). Dr Jeremy Franks, Editor of this Journal, was the other invited speaker. He took a farm manager's perspective on the value of farm management research with respect to three core aspects of farm management: (1) the value of research in risk and uncertainty, (2) opportunity costs, and (3) efficiency. As farm management involves making decisions related to the needs of the business and the family, profit motivation and business survival needs to be balanced with cash and leisure requirements. However, he claimed that much academic research fails to consider these issues and is therefore of little direct use to the farm managers who need evidence-based research that allow managers to solve the whole problem roughly rather than any single part of the problem precisely.

Brian Hardaker and Gudbrand Lien examined, in a farm management context, the merits and limitations of the conventional approach to assessing risks. They argued that problems with conventional risk assessment include; (1) not all risks are characterised by a specific adverse event and the magnitude and severity of the consequences may be uncertain, (2) typically, neither the decision maker's risk aversion nor risky up-side outcomes are taken into account, and (3) the usual one-issue-at-a time approach means that stochastic dependencies and scope for risk spreading through diversification are regularly ignored. Hardaker and Lien proposed and illustrated risk assessment (preferably in a portfolio setting) by certainty equivalents (i.e. risk-discounted monetary value) to overcome some of the above-mentioned limitations.

Farmers, in common with others, differ in their risk perception and attitudes to risk. Such differences might explain why people in seemingly similar situations choose differently. Four papers considered risk perceptions and attitudes. Carl-Johan Lagerkvist examined farmers' risk attitudes using a

psychometric approach. Economic, social, personal and environmental sources of risk were considered in the measurement of risk attitudes to produce a uni-dimensional risk attitude scale which showed that farmers have a moderate degree of risk aversion.

Victor Ogurtsov, Marcel van Asseldonk and Ruud Huirne's paper considered risk perception and attitude in relation to purchase of catastrophic insurance by Dutch arable farmers. They defined catastrophic risks as risks of low-probability events leading to serious and typically irreversible consequences. This they claimed happened quite often on Dutch arable farms, which make it relatively easy for the farmers to perceive a probability and compare consequences with the actual premiums: these farmers regularly participated in catastrophic insurance purchase. Risk perception was found to have a significant impact on predicted purchase of a catastrophic insurance, whereas risk attitude did not have such influence.

A Finnish paper by Jarkko Leppälä, Juha Suutarinen and Mervi Murtonen concluded that some risks, especially family safety, fire risks, safety in work, and electricity risks should be better noticed, while the risk estimate of machine and building breakdowns should not be adjusted.

Stochastic simulation is a flexible method for gaining insight into the risks involved in the various alternatives. Such simulations might be carried out as decision support or as a means of evaluating for instance cropping systems. James Richardson (together with Joe L. Outlaw and Luis L. Ribera) presented a paper on the economic feasibility of adding an ethanol plant to an existing (representative) sugar mill in the United States. The results indicated that the profitability would be greatly increased by adding an ethanol plant. However, the business would face significantly more variability in annual net cash income after adding the ethanol plant. Richardson claimed that a deterministic analysis would have failed to identify the increased risk and the high probability of negative ending cash reserves.

Marcel van Asseldonk and Ruud Huirne gave a paper that considered the co-existence of transgenic and non-transgenic maize. One of the major concerns regarding genetically modified crops is the risk of inadvertent admixture of genetically modified organisms (GMO) with products from conventional and organic farming. Non-GMO growers who are confronted with GMO contamination may end up with prices far lower than expected in the absence of contamination. Two relevant influencing risk factors on the probability of contamination and its economic consequences were taken into account; (1) the uncertainty of the pollen dispersal curve, and (2) the uncertainty with respect to the characteristics of adjacent fields. The losses due to the coexistence of GMO and non-GMO crops were quantified using a stochastic model that indicated that the expected number of contaminated farms and associated losses would be limited, even given unlikely scenarios.

Stochastic modelling was also applied to a Finnish study of dairy farms (Ovaska, Sipiläinen, Ryhänen and Ylätaalo). The study aimed to simulate economic success for a typical 40-cow farm in Southern Finland under three strategies for the period 2005-2014; (1) a baseline constant 40 cows, (2) moderate enlargement from 40 to 44 cows at the beginning of the period, and (3) substantial enlargement from 40 to 120 cows at the beginning of the

period. The general assumptions were based on the Luxembourg agreement on EU agricultural policy and assumed prices, yields, and culling rates were stochastic variables. Probability distributions were generated based on historical data. Given the data and assumptions, moderate enlargement was the most preferred strategy.

Lien, Hardaker and Flaten used stochastic simulation to investigate the connection between risk and economic sustainability of crop farming systems for a representative farm situation in Eastern Norway. The model could be useful in supporting farmers' choices between farming systems as well as helping policy makers to develop more sharply targeted policies.

Mean-variance (EV) methods have often been used to analysis production under risk but more recently the state-contingent approach has been developed as an alternative approach. Svend Rasmussen compared the two approaches and concluded that, under certain conditions, the state-contingent approach performed better than the EV model – but it seems that there is still a long way to go before the state-contingent method is applicable in practical farm planning and risk management.

Mogens Lund introduced a new model of risk management in agriculture. The model was developed by use of an Action Research Approach with the aim to make risk management more applicable on family farms. The basic idea was to tailor the process of risk management to individual values and goals, resources and capabilities at the individual farm. One of his conclusions was that monitoring risks is much more complex than traditional planning and control exercises typically adopted in farm management.

Heikki Isosaari examined changes in agricultural risk management after Finland joined the EU. According to Isosaari, price variation was smaller in Finland than in many other EU countries, however, it had become more difficult to form a view on the future farm income flow. Isosaari mentioned diversification and contracts (of many kinds) as two relatively new risk management strategies applied by farmers. But concluded that diversification seldom works because of lack of knowledge and market information so contracts of various kinds have become more common-place.

There were two papers examining aquaculture risk related issues. Ole Jakob Bergfjord discussed risk perception in Norwegian aquaculture, concluding, from a small sample, that fish-farmers perceived themselves to be only moderately risk averse. Future salmon prices, diseases, and regulatory issues are the most important sources of risk and traditional in-firm strategies were most widely used to manage risk. In the second paper, Bergfjord, together with Ragnar Tveterås, Gudbrand Lien and Ola Flaten, compared the relative variability in Norwegian agricultural and salmon farming. Both industries are exposed to widely varying and unpredictable elements of nature, and biological uncertainty is fundamental in both industries. However, there are also important differences; aquaculture is a relatively young industry, the institutional environment is quite different, and aquaculture is dominated by large incorporated firms while agriculture by family firms. The paper showed that aquaculture had higher variability of output, product prices and economic return: it also had a much higher profitability, on average.

A note about NJF – The Nordic Association of Agricultural Scientists

The main objective of the Nordic Association of Agricultural Scientists (Nordiske Jordbruksforskere Forening – NJF) is to promote agricultural research in the Nordic-Baltic countries. NJF arranges seminars to facilitate closer contacts between scientists, advisers and end-users of knowledge. Its vision is the efficient and sustainable utilization of agricultural and horticultural resources. NJF is organised into sections and national associations. At present, there are eight sections: Soil, Water and Environment; Crop Science; Horticulture and Landscape; Plant Protection; Animal Science; Engineering; Agricultural Economics; and Education and Extension. Each section represents a separate professional body within NJF and is fully responsible for developing its respective area.

In addition to seminars, NJF organises a congress every four years. The next congress is in Copenhagen in 2007, see <http://www.njf2007.dk/>. The main theme is Trends and Perspectives in Agriculture. For information on NJF, see <http://www.njf.nu/>. English is the official language of the association, and all seminar and congress presentations are in English.

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REFEREED ARTICLE

E-BUSINESS READINESS OF WINE PRODUCERS IN ROMAGNA (ITALY): THE IMPORTANCE OF AREA OF ORIGIN EFFECTS

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Viticulture and oenology in Romagna can boast a distinctive cultural tradition: Romagna wine makers are recognised to be able to reach high standards, and wine produced in this area seems to fit the attributes identifying a 'typical' product connotation. This study considers the general potential for use of electronic commerce as a meaningful instrument for selling in global markets a product which is firmly linked to locality. Its specific objective is to evaluate the level of e-commerce readiness for Romagna wine producers via a questionnaire survey administered to the members of the protection consortium 'Ente Tutela Vini di Romagna'. The main issues addressed in the analysis will be the role played by the attribute 'area of origin' on present marketing initiatives taken by the producers, and whether e-commerce can be considered a viable approach to improving the value of Romagna wines.

Key words: Wine, Area-of-Origin Effect, Local Economies, E-Commerce.

Introduction

Viticulture and oenology in Romagna can boast a distinctive cultural tradition: the history of the art of wine making for this Italian sub-region finds its roots back to the Etruscan period. The territory of Romagna is part of the Italian administrative region Emilia-Romagna, and entails the provinces of Ravenna, Forl -Cesena, Rimini and part of Bologna. The most common grape varieties grown are Sangiovese and Trebbiano, together with international varieties (e.g. Merlot and Cabernet Sauvignon) or local traditional varieties (e.g. Albana). Several Denominations of Origin are established in this territory, many of them making explicit reference to the geographical name 'Romagna'.

However, during the 1950s and 1960s the main goal for wine producers was the production of large quantities of cheap wine and scant attention was paid to the production of quality wines. Since the early 70s, new emerging producers have reduced the gap in reputation between regions with older traditions in quality wine production. Romagna wine makers are now recognised as being able to reach high standards, and wine produced in this terroir seems to fit the nine attributes identifying a 'typical' (local and traditional) product connotation (Mattiacci and Vignali, 2004): territory, merceology¹, legal regulation, industrial nature, time, tradition, specificity, identity, and nutritional surplus. This gives the area's wine industry a sound basis for potential new business opportunities.

The term terroir is an important one, and is here used to denote the special characteristics of geography that are able to determine specific and unique features of the food/agricultural product. In the case of wine a terroir denotes a group of vineyards (or even vines) from the same region, belonging to a

1. '... a consolidation (of) local production tradition, passed on from generation to generation, more often than not through informal means ("from father to son").' Mattiacci and Vignali (2004) p. 707.

specific appellation, and sharing the same type of soil, weather conditions, grapes and wine making savoir-faire, which contribute to give its specific personality to the wine². Thus it includes both physical and human features, taking into account the sum of the effects induced by the local environment and embodied in the product. The term has gained a wider and somewhat unclear meaning over time, while including a wide range of 'local' influences that may be transmitted into the character of the product, or sometimes denoting a countryside, a rural region at large, considered under the point of view of its specific features, like history, culture, tradition, etc.

Viewed from one perspective, the wine market is a classic example of ongoing globalisation, and the expansion of production areas throughout the world makes for intense competition in the major export markets. Thus the introduction of e-commerce - a device which allows reduction in the cost of transactions, cuts across established marketing channels, and eases the process of relationship-building should, on the face of it, be universally regarded as a valuable marketing tool. From another viewpoint, however, wine is anything but a commodity: it is a highly differentiated good, and the 'experience' and 'credence' attributes have a paramount importance in the product quality evaluation. One of these attributes is the country of origin (Felzenstein et al., 2005) or, in light of a more refined distinction among the territories frequently used in the wine markets, the area of origin. The combination of the two characteristics of the wine markets makes wine a product suitable to be included into a "glocalisation" paradigm (Mattiacci and Vignali, 2004), in which quality cues linked to the terroir (the local) are exploited to access global markets and to enhance the value of the product. Information and communication technologies (ICT) and worldwide harmonisation of trade rules promote the internationalisation of supply chains, but still companies seek the benefits of strongly localised activities. Thus in 'glocalisation' certain activities of supply chains are centralised in order to benefit from local reputation, locally widespread knowledge, economies of scale and experience, low prices of inputs, innovativeness, etc., while other activities are decentralised to obtain increased speed, flexibility and responsiveness through customisation (Lambooy et al., 2001). The glocal strategy approach reflects the necessity for local adaptations and tailoring of business activities (Post, 2000; Svensson, 2001).

In this scenario, the e-commerce tool's capacity to transfer information world-wide, may be a key instrument in pursuing a value-enhancement objective for all 'local and traditional' products which are marketed as speciality food. Thus not only is the development of wine e-commerce intrinsically interesting, but it may further be indicative of what may happen in other agricultural products and industries that are still at an early point in the e-commerce diffusion curve (Stricker et al., 2003).

Several studies have taken into consideration the commerce of wine through the World Wide Web. Some focus on web-based e-commerce transactions, especially winery-to-consumer sales (e.g. Stricker et al., 2003); others on the strategies, readiness and adoption intentions of the wineries (Richardson, 2002). The literature on the country of origin's effect on the

2. See <http://www.terroir-france.com/theclub/meaning.htm>

consumers and on foreign trade is vast, as is that on the narrower concept of area (or region) of origin. Within this literature, the review of Verlegh and Steenkamp, 1999, and other more recent papers provide a wide view of the issues (Van der Lans *et al.*, 2001; Van Ittersum, 2003; Felzenstein *et al.*, 2005). Most of these contributions confirm that area-of-origin affects both consumer preferences and firms' business strategies. Area of origin as a quality cue even seems able to moderate the sensory perception for certain food (Stefani *et al.*, 2006). As a signal of the additional opportunities offered by the global marketplace for niche agricultural products and foodstuffs, there has been a worldwide growth in interest about international protection of geographical indications (GIs), which has also raised problems related to negotiations for the harmonisation of trade rules across the borders of market areas (Evans and Blakeney, 2006). However, to the best of our knowledge no study has addressed the issue of area-of-origin as a determinant and an element of e-commerce strategy. Our study thus considers the use of electronic commerce as a meaningful instrument for selling the terroir-linked wine abroad, both on the EU and overseas markets. Within this framework, the main objective of this paper is to evaluate the level of attention to e-commerce for Romagna wine producers, and the importance assigned by them to the area of origin feature.

Objectives and Methodology

The main focus of this study was the role played by 'area-of-origin' in current marketing initiatives taken by the producers. An important issue in this context is whether e-commerce is considered a viable solution by producers, and whether it has more potential if used as a single-business tool for wine makers or handled by a third party, whether as an independent venture business or as a collective marketing action. The results will be useful for the elaboration of strategies aimed at enhancing the value of Romagna wines, and may be transferable both to other wine-producing areas and to marketing of other local-specific food and drink products.

The study used a face-to-face survey of 59 of the 88 producing members of the Romagna wine protection consortium 'Ente Tutela Vini di Romagna' (ETVR), which was founded in 1962. The sample was selected so as to exclude those members who represent marketing and distribution businesses rather than the actual production of wine³. Twenty-five interviews were undertaken at the international oenological exhibition 'Vinitaly 2005', Verona. The remainder were interviewed at their farm/vineyard; occasionally personal interviews were not possible so the respondent treated the questionnaire as a postal survey. There were no significant differences in terroir-attitude and e-commerce adoption between the groups, using chi-square test, giving confidence that the data could be aggregated for the purposes of analysis. The questionnaire was carefully tested and improved during its development, and was structured in three parts: general vineyard information

3. At the time of the survey the ETVR had 102 members. Fourteen of them were just bottlers, thus they were excluded from the survey, while 11 were co-operative wineries and 77 were private wine makers. Even though all producers asked did agree to participate, only 65 out of 88 actually responded to the survey, and 5 of the returned questionnaires have been set aside because of incompleteness. The response rate is very high (almost 70%), but since the sampling method is not stochastic, selection bias may affect the sample data.

and characteristics; marketing initiatives taken by the producers; level of e-business inclination and perceptions of the importance of area-of-origin in enhancing the value of the respondent's product.

The questionnaire allowed collection of a large amount of information, of which only some is considered here. In order to select the most relevant variables to be discussed, a series of Chi square tests were performed between several combinations of cross-tabulated data. This allowed assessment of the probability of independence between the variables, and further investigation of those showing a significant relationship. The key variables in this group were:

- Vineyard area (hectares);
- Management average age (years);
- Share of output accounted for by quality wine (percentage);
- Share of total sales to international markets (percentage);
- Computerisation Level (composite index),

In establishing marketing profiles, nominal measures were used to research the existence of a marketing function, marketing manager, the integration of marketing in the sales function, the integration of marketing within top management, and the existence of an external marketing advisor. The importance of marketing functions employed 5-point scales with respect to planning, new product development, research and analysis, promotion, and advertising. Questions about the percentage of sales through different outlets (wholesale, traditional retail, e-commerce, etc) allowed the development of a distribution profile. The promotional profile depended on a mixture of nominal measures relating to engagement in promotional activity and branding, and scale measures relating use of different promotional media.

A specific question considered the adoption of e-commerce tools as a marketing option. The responses allowed wineries to be classified in three groups: non adopters (with no intention to adopt); non-adopters (but willing to adopt in the future); and adopters.

Further questions sought the perceptions of respondents of the importance of the following factors as influences on the decision to adopt e-commerce tools: Investment required;

- Product suitability;
- Security issues;
- Client demand;
- On-line competition;
- Logistic issues.

Finally, a question was specifically focused on the respondents' perception of the role of area of origin in the enhancement of the value of the winery products, expressed on a 5-point Likert scale from low to high importance.

Survey results

Table 1. General information and product profile basic statistics.

	N	Mean	Standard	Percentiles		
	valid		deviation	25	50	75
Employees (no.)	59	11.7	21.15	3.00	5.00	13.00
Sales (€'000)	41	2,543	5,249	175.00	500.00	2,900
Vineyard area (hectares)	58	434.3	1,627	11.00	20.00	41.75
Average age of the winery management staff (years)	54	44.6	8.65	40.00	42.00	50.00
Share of higher quality product - fine wines (%)	60	71.6	32.15	40.00	89.00	100.0

Source: Survey data

A general picture of the respondents' businesses is given by Table 1. Not all respondents were willing and/or able to supply data for each question (hence, for instance, the low response to a question about sales turnover).

The Romagna sub-region is a rather small area and the farmland structure has been fragmented, so there is a large number of small-medium sized farms and vineyards; in that respect at least the sample reflects the nature of Romagna wine production. While the mean value is high, most of the firms surveyed are very small, with respect to both the number of employees and on the surface area available for vineyard cultivation. The distribution is strongly skewed to the left, since 53.4% of the surveyed farms manage a vineyard surface smaller or equal than 20 hectares, and 86.2% less than 100 hectares.

The mean age of the winery management staff is quite stable, around 45 years, but it should be pointed out that the respondents are probably younger than the non-respondents, so this parameter may be biased.

The 'quality' attribute for wine production is segmented into two, each characterised by different marketing mix strategies; the so called 'beverage wines' (table wine) and the so called 'fine wines' (Spawton 1991). Elements such as geographical indication, grape variety, limited quantity, ageing and region belong to the 'fine wine' segment are used to define the quality wine for the purposes of this research. The average value of quality wine production for the vineyards' sample is higher than 50%, a significant proportion is regarded as a 'beverage wine'.

The share of quality wines is highly diversified, and it needs further explanation. One of the firms surveyed is an important supplier of bulk wine.

Other wineries are old-fashioned co-operative cellars, mainly devoted in making standard quality wine from the grapes supplied by their associates. The smallest wineries are mostly involved in higher quality production, sometimes reaching top-quality standards.

Also as a consequence of the small size, the marketing profile of the wineries (Table 2) shows a rather low commitment to marketing management. A marketing role can be specifically identified in just 32% of the enterprises, while in the remainder it is mostly seen as part of sales. Key aspects of marketing management (especially research and planning) are not considered to be much more important than promotion and advertising, possibly displaying a naive and superficial concept of marketing. But some 35% do use a marketing advisor.

Table 2. Marketing profile basis statistics (N=60)

	Mean*	Std. Deviation	Percentiles 25	50	75
Marketing Planning	3.03	1.34	2.00	3.00	4.00
New products development	3.08	1.28	2.00	3.00	4.00
Marketing research and market analysis	2.48	1.32	1.00	2.50	3.00
Promotion	3.27	1.26	3.00	3.00	4.00
Advertising	2.97	1.25	2.00	3.00	4.00
	% 'yes'				
The marketing function exists	31.7				
A marketing manager exists	36.7				
Marketing is included in the sales function	75.0				
Marketing is part of top management	73.3				
External marketing advisor	35.0				

* Of responses to a 5-point scale where 1 = low importance, 5= high importance.

The distribution profile (Table 3) is also diverse, but with a prevalence of domestic sales.

Table 3. Distribution profile basic statistics (N=60).

	Mean	Std.	Percentiles		
	%	Deviation	25	50	75
Domestic Sales	84.85	15.90	72.00	90.00	99.75
Sales through:					
Large-scale retailers	6.23	17.79	00	00	00
Traditional retailers	18.98	27.37	00	5.00	27.50
Wholesalers	22.20	28.45	00	10.00	30.00
Direct marketing	34.23	34.45	7.75	20.00	60.00
Direct marketing through e-commerce	0.23	1.32	00	00	00
Hotel-restaurant-catering (HO.RE.CA.)	8.05	20.30	00	00	8.75
Wine cellars	6.02	19.77	00	00	00
Other wine traders	3.55	14.17	00	00	00

Table 4. Promotion profile basic statistics (N=60).

	%	Std.	Percentiles		
	'yes'	Deviation	25	50	75
Engages in promotional activities	93.3				
Uses registered private brand	63.3				
Uses collective brand	100.0				
Uses for promotion:					
	Mean*				
TV	1.55	1.24	1.00	1.00	1.00
Radio	1.38	0.76	1.00	1.00	1.75
Press	2.65	1.34	1.00	3.00	4.00
Brochures	3.32	1.20	3.00	3.00	4.00
Internet	2.58	1.29	1.00	3.00	3.75
Other media	2.97	1.55	1.00	3.00	4.00

* Of responses to a 5-point scale where 1 = low importance, 5= high importance.

The average percentage of domestic sales for the 60 wineries is about 85%, and domestic sales represent 89.2% of total sales in aggregate for the 41 wineries that declare their sales, so exports play a minor role in the market choices of most wineries. Nevertheless more than 50% of the producers interviewed have commercial trade abroad, even though both the median and mean values of exports are far less than 20% of total sales. According to the collected data, exports are concentrated on Europe, particularly Germany, whilst United States and Japan are the main destination markets outside Europe.

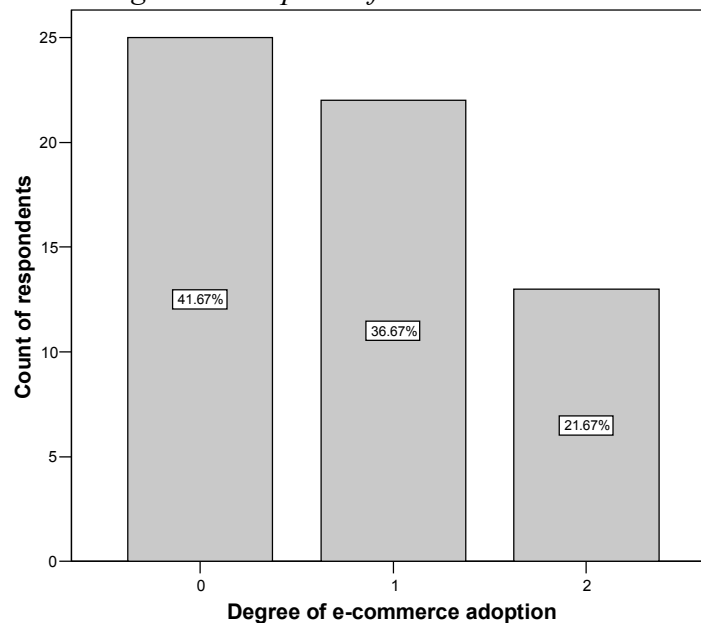
Table 5. E-business readiness basic statistics.

	N valid	Mean	Std. Devn.	Percentiles		
				25	50	75
Technology provision in firm						
Personal computers (PCs) (no.)	60	4.27	8.15	1.00	2.00	3.75
PCs connected to a LAN (no.)	60	3.70	8.12	1.00	1.00	3.75
PCs connected to the Internet (no.)	60	3.67	8.02	1.00	1.00	3.00
		%				
Server (%)	60	38.3%				
Internet manager (%)	60	45.0%				
Web site (%)	60	78.3%				
Internet connection type (%)						
	57	%				
No connection	1	1.8%				
56 Kbps	12	21.1%				
ISDN	14	24.6%				
ADSL	29	50.9%				
Optical fibre	1	1.8%				
Factors influencing adoption of e-commerce (5-point scale from 1 (low importance) to 5 (high importance))						
		Mean				
Investment (5-point importance scale)	60	2.48	1.47	1.00	2.00	
Product Suitability (5-point importance scale)	60	3.22	1.56	1.00	4.00	
Security Issues(5-point importance scale)	60	3.03	1.62	1.00	3.00	5.00
Client Demand (5-point importance scale)	60	3.12	1.49	2.00	3.00	5.00
On-line Competition (5-point importance scale)	60	2.15	1.25	1.00	2.00	3.00
Logistic Issues (5-point importance scale)	60	2.87	1.62	1.00	3.00	4.75
Interest in e-commerce options (5-point scale from 1 (low interest) to 5 (high interest))						
		Mean				
Private EC Solution (5-point interest scale)	60	3.33	1.59	2.00	3.50	5.00
Third Party EC Solution (5-point interest scale)	60	2.97	1.63	1.00	3.00	5.00
Individual EC Solution (5-point interest scale)	60	3.62	1.34	3.00	4.00	5.00
Collective EC Solution(5-point interest scale)	60	3.18	1.33	2.00	4.00	4.00

The promotion profile of the sample (Table 4) clearly shows that on average the most important communication medium is printed advertising material, while on a second level of importance are placed on both the press and the Internet web site. About 90% of the cellars perform promotional activities of various type, like participation in international, national, and local fairs as well as initiatives like the so called "open cellars" and tourism-linked activities.

Even though an operational web site is cited by most interviewees, the adoption of a real e-commerce solution is limited to about 20% of the wineries (Figure 1). However, the non-adopter wineries may be split out in two almost equal groups: the larger one is not interested to an e-commerce solution at all, but about 35% of the wineries are actually planning to implement this commerce solution within their organisation in the near future.

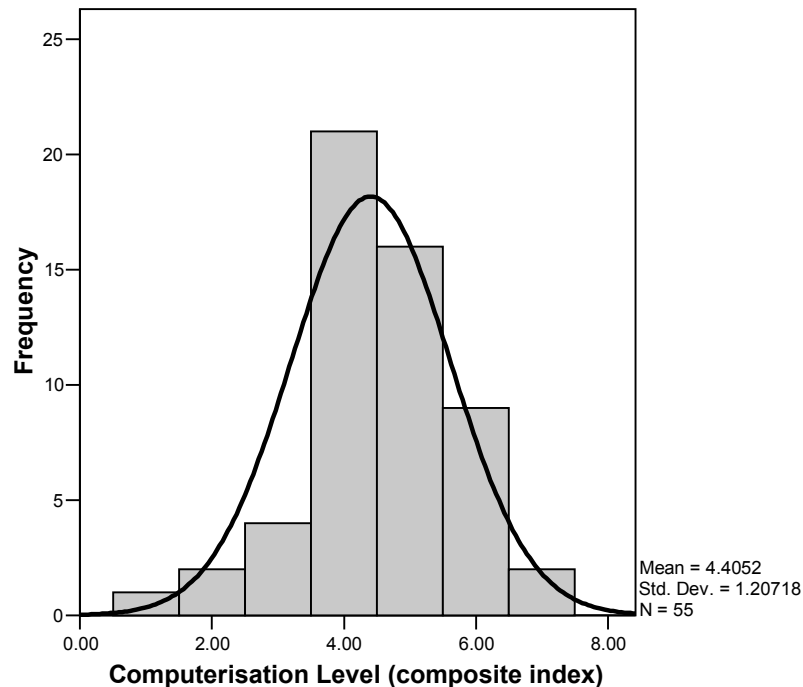
Figure 1. Adoption of an e-commerce service.



The questionnaire collected information on the evaluation of the factors affecting their decision to implement or not implement e-commerce (EC), on the structural conditions of the firms regarding IT tools and infrastructure, and on the preference for different e-commerce implementation solutions (private, third-party, individual, collective). (Table 5)

The structural information was used to calculate a composite index for the single wineries. This composite index was calculated by combining the output value for seven variables: presence of a server (0=no or 1=yes), number of computers compared to employees (nPC/nEmp), quota of computers connected to a local area network (lanPC/nPC), quota of computers connected to the Internet (netPC/nPC), type of Internet connection (0-4), presence of an LAN/Internet manager (0 or 1) and of a web site (0 or 1). Consequently, the population may be classified into three groups labelled as "poor" (1st quartile),

Figure 2. Distribution of the computerised level composite index.



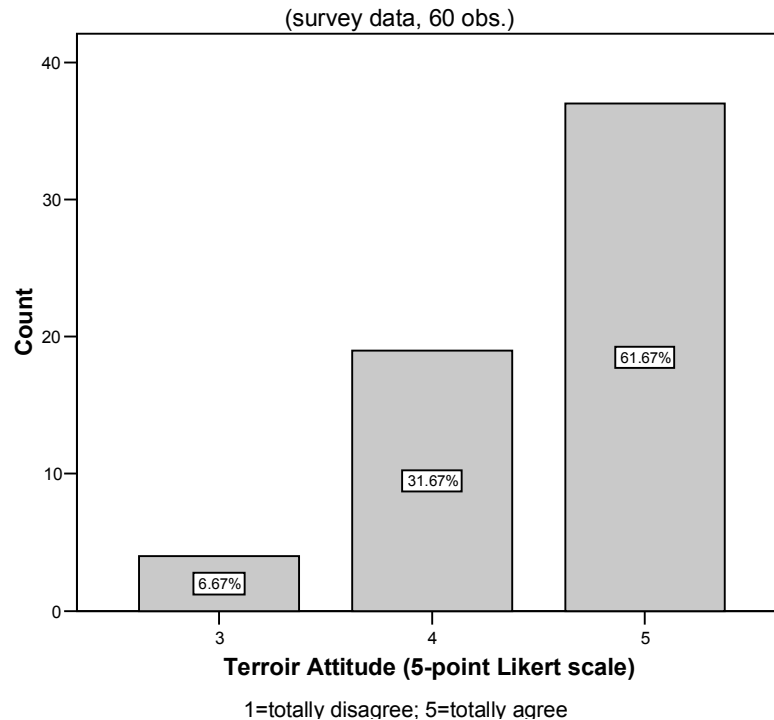
"average" and "high level" (4th quartile) of computerisation, according to the score achieved on the composite index. The distribution of the score is shown in Figure 2.

The final question focused on the role played by area of origin in the value attribution of consumers, according to the interviewee's opinion. This formulation was chosen because, in our view, it sheds a light on the attitude of the wine-maker towards value-enhancement initiatives linked to the terroir concept. It should be noted that this single-item question may not be able to distinguish between the several facets of and motivations for a terroir-attitude. Some components like producer ethnocentrism versus beliefs on consumer ethnocentrism (Shimp and Sharma, 1987; Al-Sulaiti and Baker, 1998; Moon and Jain, 2002; Orth and Firtbasovß, 2003; Martinez-Carrasco et al., 2005; Brown and O'Cass, 2006), as well as beliefs on the wine production area reputation, are not actually explored in this survey. However, it should be able to differentiate the interviewees just on the base of the synthetic expression of their terroir-attitude. The distribution of responses is shown in Figure 3. It is apparent that the perception of the role of the terroir in enhancing the value of the product is largely positive, even if a small proportion (7%) of neutral answers is noticeable. None of the respondents had a negative opinion on the role of area-of-origin.

Data analysis

The exploration of the interrelations between the variables is limited to the two focus variables considered in this paper, i.e. e-commerce adoption and terroir-attitude. Pearson Chi Square Tests were used to verify the

Figure 3. Importance of the Terroir-attitude of consumers, according to the respondent.



non-parametric independence of the variable, and one-way ANOVA used to examine the significance of differences in group means. The wineries were classified in three groups: Non adopters; Willing to adopt; Adopters, and group means for specific data, and response to the adoption of e-commerce tools as a marketing option, indicate relationships and influences.

The main test statistics for some of the variables are reported in Table 6, namely the Chi Square Test and the one-way ANOVA test. Some of the variables have been tested with both methods, even if the ANOVA test is not fully appropriate for rating scales and must be considered with caution, since the discrete nature of the 5-point scales may let us consider them both as nominal and ordinal variables.

It is interesting to note that the two variables terroir-attitude and e-commerce adoption are probably not independent, since they satisfy the condition $\chi^2 > \chi^2_{0.05}$ for a Chi square test and a relationship is highlighted also by the F test at $p < 0.01$. The mean levels of the terroir-attitude score for the three groups of firms interviewed are shown in Figure 4. The average group score is significantly higher for non-adopters than for adopters, even if the absolute difference is not that large.

An interesting aspect may be also pointed out: the group of non-adopters who state an intention to adopt an e-commerce tool in the near future have a mean score for the terroir-attitude almost equal to that of strict non-adopters. This issue is worth exploring further in subsequent analysis.

Table 6. Statistical tests on the interaction with the variable "E-commerce adoption".

	ANOVA		Peason Chi-square				
	F	Sig.		Value	df	Asymp. Sig. (2 sided)	
Employees (no.)	0.596	0.554					
Sales (.000 EUR)	2.134	0.132					
Vineyard dimension (hectares)	0.549	0.580					
Average age of the winery management staff (years)	0.638	0.533					
VQPRD wines share (percentage)	0.350	0.706					
International Sales (percentage)	2.252	0.114					
Computerisation Level (composite index)	0.367	0.695					
Logistic Issues (5-point importance scale)	2.580	0.085		12.06	8	0.148	
On-line Competition (5-pt importance scale)	3.909	0.026	*	15.98	8	0.043	*
Client Demand (5-point importance scale)	3.357	0.042	*	13.02	8	0.111	
Security Issues(5-point importance scale)	5.413	0.007	**	12.29	8	0.139	
Product Suitability (5-point importance scale)	2.855	0.066		12.20	8	0.143	
Investment (5-point importance scale)	4.036	0.023	*	10.73	8	0.217	
Collective I. Solution(5-point interest scale)	4.401	0.017	*	19.17	8	0.014	*
Third Party I. Solution (5-point interest scale)	1.334	0.272		12.03	8	0.150	
Individual I. Solution (5-point interest scale)	0.684	0.509		10.31	8	0.244	
Private I. Solution (5-point interest scale)	1.104	0.338		14.26	8	0.075	

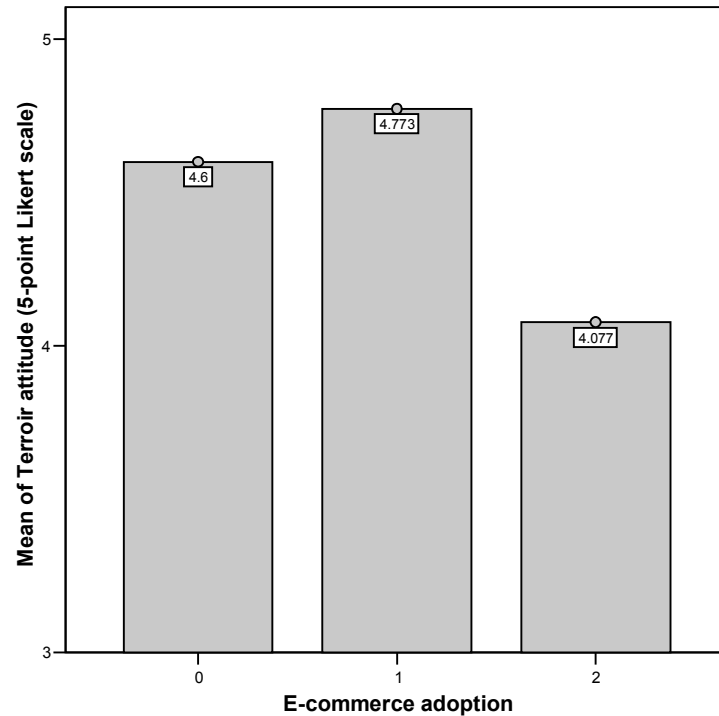
* significant at 95% confidence level ; ** significant at 99% confidence level.

See Appendix 2 for full ANOVA results

The computerisation index does not show a significance differences by e-commerce adoption. This brings us to assume that the adoption of e-commerce is more linked to managerial choices than to structural conditions.

Conclusions

The preliminary results of the analysis performed on the wineries enrolled in the 'Ente Tutela Vini di Romagna' consortium shows mixed trends. On one hand, a significant number of producers are interested in implementing an e-commerce facility within their marketing organisation, and most of the firms are quite well-prepared to adopt it. On the other side, there is still a strong orientation towards individual solutions, whose efficiency may suffer for the small dimension of the single businesses. However, since the Internet offers the smaller producer the opportunity to break away from the hegemony of the large-scale distributor (whether independent or collective), and provide him with entrepreneurial opportunities that were not available before, we do not assume that reluctance to cooperate in this context is necessarily an irrational business decision.

Figure 4. Mean plot of terroir attitude by e-commerce adoption groups.

Furthermore, even though the opportunity to promote traditional and local wines on the Internet is not excluded, there are some hints that the e-commerce tool is perceived as not completely coherent with a logic of value enhancement, achieved through focusing on the local dimension and to the importance of the area of origin. Obviously, this is just the perception shown by the Romagna wine producers, and it could be confirmed or denied through a specific study involving the analysis of the purchase behaviour on the Internet, performed both on professional buyers and consumers. Nevertheless, the fact that such a perception exists is an important factor in determining the potential of e-commerce not only for wine, but also for a wide range of speciality food and drink products relying on local identity as a mark of quality.

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Biographical notes

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Appendix 1: Details of questionnaire

General information: e.g. Employees, Yearly turnover, Vineyard extension (ha), Average age of the management staff,

Product profile: Share of beverage and fine wine produced.

Marketing profile: the presence of a marketing activity/function, marketing manager, marketing separated from the sales function, marketing in the top management; the importance for elements of marketing policy (5-point importance scale: 1=lower importance to 5=higher importance): Planning, New products development, Marketing research, Promotions, Communication/Advertising, the use of an external marketing advisor

Distribution profile: percentage of sales in national, EU and extra-EU markets; percentage of sales to Large-scale retailers, Traditional retailers, Wholesalers, Direct sales to consumers, etc., including e-commerce.

Promotion profile: promotional activities; importance of the media (5-point importance scale: 1=lower importance to 5= higher importance): Television, Radio, Press, etc.; presence of a registered brand

E-business readiness: use of an e-commerce service (Yes, No, but shows interest in implementing it, No); the importance for factors influencing the decision to adopt or to not adopt an e-commerce service for the winery (5-point importance scale: 1=lower importance to 5=higher importance): Investment required; Product suitability; Security issues; Client demand; On-line competition; Logistic issues); presence of a central server; total number of computers; Number of computers connected to a local area network; Number of computers connected to the Internet; type of Internet connection; presence of an Internet manager; presence of a web site; interest in different options to implement an e-commerce service (5-point Interest scale: 1=lower interest to 5= higher interest): Own web site; Web site handled by a third party; Individual marketing and e-commerce solution; Collective marketing and e-commerce solution.

Area-of-origin: (dis)agreement of the interviewee with the statement that area-of-origin plays a fundamental role in influencing final consumer behaviour (5-point Likert Scale: 1=totally disagree to 5=totally agree).

Appendix 2. Statistical tests on the interaction with the variable “E-commerce adoption” full details.

ANOVA		Sum of squares	df	Mean square	F	Sig.
Employees (no.)	Between Groups	541.2	2	270.6	0.596	0.554
	Within Groups	25,408.9	56	453.7		
	Total	25,950.1	58			
Sales (.000 EUR)	Between Groups	111,274,393.8	2	55,637,196.9	2.134	0.132
	Within Groups	990,594,871.8	38	26,068,286.1		
	Total	1,101,869,265.6	40			
Vineyard dimension (hectares)	Between Groups	2,957,087.9	2	1,478,543.9	0.549	0.580
	Within Groups	148,032,880.6	55	2,691,506.9		
	Total	150,989,968.5	57			
Average age of the winery management staff (years)	Between Groups	96.8	2	48.4	0.638	0.533
	Within Groups	3,870.2	51	75.9		
	Total	3,967.0	53			
VQPRD wines share (percentage)	Between Groups	1,039.1	2	519.5	0.350	0.706
	Within Groups	84,571.9	57	1,483.7		
	Total	85,611.0	59			
International Sales (percentage)	Between Groups	1,092.0	2	546.0	2.252	0.114
	Within Groups	13,819.6	57	242.4		
	Total	14,911.7	59			
Computerisation Level (composite index)	Between Groups	1.1	2	0.5	0.367	0.695
	Within Groups	77.6	52	1.5		
	Total	78.7	54			
Logistic Issues (5-point importance scale)	Between Groups	12.9	2	6.4	2.580	0.085
	Within Groups	142.1	57	2.5		
	Total	154.9	59			
On-line Competition (5-point importance scale)	Between Groups	11.1	2	5.5	3.909	0.026 *
	Within Groups	80.6	57	1.4		
	Total	91.7	59			
Client Demand (5-point importance scale)	Between Groups	13.7	2	6.9	3.357	0.042 *
	Within Groups	116.5	57	2.0		
	Total	130.2	59			
Security Issues(5-point importance scale)	Between Groups	24.6	2	12.3	5.413	0.007 **
	Within Groups	129.4	57	2.3		
	Total	153.9	59			
Product Suitability (5-point importance scale)	Between Groups	13.1	2	6.6	2.855	0.066
	Within Groups	131.1	57	2.3		
	Total	144.2	59			
Investment (5-point importance scale)	Between Groups	15.8	2	7.9	4.036	0.023 *
	Within Groups	111.2	57	2.0		
	Total	127.0	59			
Collective I. Solution(5-point interest scale)	Between Groups	14.0	2	7.0	4.401	0.017 *
	Within Groups	90.9	57	1.6		
	Total	105.0	59			
Third Party I. Solution (5-point interest scale)	Between Groups	7.0	2	3.5	1.334	0.272
	Within Groups	149.0	57	2.6		
	Total	155.9	59			
Individual I. Solution (5-point interest scale)	Between Groups	2.5	2	1.2	0.684	0.509
	Within Groups	103.7	57	1.8		
	Total	106.2	59			
Private I. Solution (5-point interest scale)	Between Groups	5.6	2	2.8	1.104	0.338
	Within Groups	143.8	57	2.5		
	Total	149.3	59			
Terroir Attitude (5-point Likert scale)	Between Groups	4.1	2	2.0	6.164	0.004 **
	Within Groups	18.8	57	0.3		
	Total	22.9	59			

REFEREED CONFERENCE PAPER**SIR THOMAS MIDDLETON MEMORIAL LECTURE¹****RESPONDING TO THE CHALLENGES OF POLICY
DECOUPLING AND MARKET LIBERALISATION: THE
CASE OF THE UK SUGAR INDUSTRY**

Carl Atkin

2005 saw the most radical reform of the EU Sugar Regime for about forty years. This paper looks at the historical development of sugar beet production in the EU, the major drivers for reform and some of the likely outcomes. It concludes that the reform package will have a major impact on sugar production in Europe with beet producers becoming larger and more specialist. It notes that the unique position of the single negotiated price is probably not in the long terms interests of the largest growers or of the overall supply chain efficiency. Unless the UK supply chain is able to reach optimum efficiency there are dangers that sugar production could be exported overseas, to the detriment of UK growers.

Introduction

Recent Common Agricultural Policy (CAP) reforms have led to the most liberalised agricultural European markets since the formation of the CAP in the early 1960s. Whilst there is more to do, including removing the oddities of set-aside, production quotas for milk and the further dismantling of the intervention system, the 'Mid Term Reform' of 2003 looks set to run its course to 2012 relatively unchanged by the 'Health Check Proposals' expected to be presented by the Commission to Council during the first half of 2008.

This aim of this paper is focus on how the UK sugar industry – farmers, processors and other stakeholders – responds in this new environment of decoupled support and increasingly liberalised markets. It is a sector which has been more heavily protected than most, and for its own special reasons, has remained untouched by reformers for several decades. The paper looks at the historical development of the industry and the policy instruments, the reforms of 2005 and suggests some likely impacts on the UK industry at farm and supply chain level.

'Mid Term Reform' of the CAP as it has become known was, and is, all embracing, but it has taken a while to get there. Initially even Franz Fischler was not brave enough to tackle sugar, focussing on the 'easier' regimes of arable and livestock in 2003. Given that he was 'on a roll' securing a pretty favourable deal for the Commission in Luxembourg he went on to tackle the so-called Mediterranean regimes (olive oil, hops, tobacco, cotton) in 2004 and finally, in 2005, he wrestled with the vexed question of sugar. For many this was long overdue, a situation acknowledged by his successor Mariann Fischer Boel (Fischer Boel, 2005a). Only fruit and vegetables, wine and bananas together with a small number of other products await the full implementation of their reform packages and their eventual alignment with the single payment

1. This paper was presented at the UK National Farm Management Conference held at Basingstoke, 15 and 16 November 2006.

scheme (SPS).

Background

The Historical Development of Sugar Production

Prior to 1800 Europe was entirely dependent on cane sugar produced principally in the West Indies and South America. Throughout the seventeenth and eighteenth centuries many colonies in the Caribbean were the largest producers of sugar in the world. Sugar-plantations fuelled a demand for manpower; between 1701 and 1810 ships brought nearly one million slaves to work in Jamaica and Barbados alone.

In 1747 a German chemist called Andreas Marggraf first identified sucrose in beet roots, but it was not until the Napoleonic Wars of the early nineteenth century and a ban on cane sugar imports that a European beet-sugar industry emerged. It grew rapidly and today, sugar-beet provides approximately 30% of world sugar production. By the end of the Napoleonic Wars, over 300 beet sugar mills operated in France and central Europe, with the first U.S. beet sugar mill opening in 1838. Britain lagged far behind France and Germany in establishing a 'home-grown' sugar industry, mainly because there was no sense of urgency: our cane refineries were plentifully supplied by plantations in the colonies and cheap, raw beet sugar was available from the Continent.

While no longer grown by slaves, sugar from developing countries has an on-going association with workers earning minimal wages and living in extreme poverty. The political arguments surrounding sugar production, protectionism and the use of policy instruments by various regional trading blocs means that the commodity remains more politically sensitive than most.

Development of the UK Sugar Industry and Associated Policy Instruments 1850-1973

Sugar refining has a long history in the UK. There were numerous small privately owned refineries across the UK but it was during the 1850s and 1860s that two of the best known names in cane sugar production began refining independently: Henry Tate began refining sugar in Liverpool and Abraham Lyle at Greenock in Scotland (Hugill, 1978). Both businesses separately developed refineries in East London during the early twentieth century and eventually merged as Tate & Lyle in 1921.

In parallel with these developments during the early twentieth century domestic sugar beet activity began; the first factory opened at Cantley in 1912, three years after the formation of the "National Sugar Beet Association". By the end of the First World War, domestically produced sugar still amounted to a tiny proportion of UK production and on 1 September 1919, a new regime of preferential tariff treatment was extended to British Empire Sugar at varying rates, and then between 1925 and 1928, preference was established for Empire Sugar. In 1925, the first major government intervention in domestic sugar production occurred. The Sugar Industry (Subsidy) Act of 1925, made investment in new sugar beet factories far less risky by providing direct subsidies from the Exchequer, on a decreasing scale over ten years. Fifteen more factories were built in the four years from 1925 to 1928, bringing the

total of British beet sugar factories to 18.

World over-production from the mid 1920s to the early 1930s led to a further fall in world sugar prices during the British industry's ten year subsidy period. Alarmed at the potential collapse of the new domestic industry, the Government set up the Greene Committee in 1934 to enquire into the condition of the sugar industry in the United Kingdom.

When the committee presented its report in March 1935, members commented in glowing terms on the value of the beet crop to British agriculture. However two members, including the chairman Mr Wilfred Greene (later a peer and Master of the Rolls) stated they were unable to recommend continued government support for 'an industry which has no reasonable prospects of ever becoming self-supporting...'. They did, however, put forward a comprehensive series of recommendations for the unification and reorganisation of the industry. In July of the same year the Government issued a White Paper which became the basis for legislation setting up the British Sugar Corporation. As well as declaring that it was desirable, on agricultural grounds, to continue to subsidise production of up to 560,000 tonnes of white sugar per year for an unspecified period of time, the White Paper also proposed the appointment of an independent Sugar Commission and the amalgamation of existing factories into a single corporation. The Sugar Industry (Reorganisation) Act 1936 was passed and the British Sugar Corporation (BSC) was founded. The Treasury held £750,000 of the corporation's £5,000,000 share capital on behalf of the Government in recognition of the public subsidy that went into the creation of the industry.

The Nationalisation of the British Sugar Corporation was proposed in October 1950 just a year after the proposed Nationalisation of Tate and Lyle but neither occurred due to lack of parliamentary time. After this, although the government's stake in BSC was still only 36 per cent, many people mistakenly believed that British Sugar was a nationalised industry. It was an industry controlled by the government but not wholly owned. The government did not sell its shareholding until 1981- 45 years after it had been acquired.

In parallel with the changes to the domestic industry, the Empire situation was under review. In 1948, discussions began on a long-term agreement with the colonies. The British government wished to obtain assured supplies from the sterling area, both for balance of payments reasons and in order to lift the rationing of sugar as soon as possible. The result was the Commonwealth Sugar Agreement (CSA), signed in London on 21 December 1951, which gave formal effect to the principles which had been followed during the preceding years.

The objectives of the CSA were stated as follows: "This Agreement is formalised from the general understanding that has been reached between the parties that is desirable on the terms and conditions arrived at to have a long-term agreement for supplying sugar to the United Kingdom, for developing the production of sugar in the Commonwealth countries and for the orderly marketing of that sugar."

The Sugar Act of 1956 put legislation relating to the BSC on a permanent footing. It replaced the 1936 Act and temporary legislation which had come into force as a result of the war. The Act ended state trading in sugar and set

up the Sugar Board, whose functions would be to buy commonwealth sugar under the Commonwealth Sugar Agreement, at a subsidised price and sell it commercially, to pay the corporation whatever subsidy was necessary to fund the guaranteed price for growers, and to levy a tax on consumers to fund both these subsidies.

Entry into the European Union

Entry to the EC in 1973 brought a new atmosphere of competition to the British sugar industry. In the past there had been a statutory market sharing agreement: BSC would supply the eastern part of the country, while the cane sugar refiners, most notably Tate & Lyle, would supply the west and south regions.

In 1975 the Government White Paper 'Food from our own Resources' (HMSO, 1975) singled out sugar beet as one of the crops which could help with Britain's massive food imports bill. Worldwide, demand for sugar had been increasing faster than production, with the result that in 1974 world sugar prices had soared to unprecedented levels. The paper pointed out that the EEC was encouraging increased sugar beet production and had raised Britain's beet quota accordingly. It called upon the home-grown beet sugar industry - then supplying a third of the sugar consumed in Britain - to boost production to 1.3 million tonnes of sugar per year in order to meet half the nation's sugar needs. Resultant investments and improvements over the past twenty years have led to about 60% of domestic sugar needs being met by home grown beet production.

The UK and EU Sugar Industry in the Global Context Today

The UK Position

In the late 1990s sugar beet was grown on about 183,000 ha; an area which had fallen to 154,000 ha by 2004 (DEFRA, 2005), the fall largely due to the reduction in 'C' beet production and the displacement of beet by oilseed rape and cereals. Average yields have increased but still were only 54 t/ha over the period 2000 to 2004.

Prior to the restructuring scheme of 2006, there were almost 7000 growers of sugar beet, principally in East Anglia, the East and West Midlands and Yorkshire. These growers produced about 9 million tonnes of beet on contract to British Sugar plc who of course held (and still hold) the national UK quota. This beet produced on average, about 1.5 million tonnes of sugar (or 60% of UK refining), with the industry representing 2% of total UK agricultural output and supporting between 10,000 and 20,000 jobs in farming, processing and transport (RBU, 2004).

Pollitt (2006), in a newspaper interview with Karl Karter, notes that the restructuring following the 2005 reforms has reduced the number of growers to 5,080, with 175 new entrants acquiring tonnage. Most significantly for British Sugar, the number of large growers with more than 10,000 tonnes of contract has doubled to 50, whilst at the bottom end the number of small growers with fewer than 500 tonnes has fallen from 2,650 to 1,670 – a step in the right direction, but probably not a big enough rationalisation from British

Sugar's point of view. The overall effect of this 'one off' industry restructuring was to increase the average contract size by 23%, produce a very slight reduction in average contract distance (to 28 miles) and encourage the increased specialisation of sugar production to larger, more commercial farmers.

The UK consumes around 2.25 million tonnes of sugar per year, approximately 75% of which is sold direct to industrial users such as soft drinks and confectionery manufacturers. Consumption remains more or less constant.

Sugar Production in the EU 15 and EU 25

Prior to the 2004 enlargement, sugar beet was grown on 1.8 million hectares in the old EU 15, or 1.2% of the utilised agricultural area (UAA). Holdings growing sugar beet tend to be larger than the average, being some 70 ha, with an average of 8 ha in sugar beet, in contrast to an average of 20 ha for holdings as a whole (Commission, 2003). Sugar production in the old EU 15 varied between 15 and 18 million tonnes grown under contract to 30 firms owning 135 sugar-mills and 6 refineries scattered throughout sugar beet growing regions. All Member States except Luxembourg grow sugar beet. France and Germany account for more than half of the old EU15's production, followed by the UK and Italy, each accounting for 8%.

With the accession of ten new countries in mid 2004, the area under sugar beet increased by about 30% and sugar production by 15%, with Poland producing about 2 million tonnes of the 3 million tonnes additional production. On the whole yields in these countries were somewhat behind UK levels (with the exception of the Czech Republic) and an NFU report on enlargement concluded "there is likely to be no major impact on British sugar beet growers of enlargement in the short run." (Michel-Berger, 2004)

Table 1. Top 10 Beet Producing Countries in the World (2005)

Country	Tonnes of beet produced per annum
France	29.3 million
Germany	25.4 million
United States	24.7 million
Russian Federation	21.5 million
Ukraine	15.6 million
Turkey	13.5 million
Italy	12.0 million
Poland	10.9 million
China	7.9 million
United Kingdom	7.5 million

Source: FAO (2005)

The World Sugar Market

The old EU 15 made up 13% of world production, 12% of world consumption, 15% of exports and 5% of the world imports. Since 1996 Brazil and India have taken over as leading sugar producers, together accounting for 30% of world supply. However, when looking at beet alone (30% of total global sugar production), the situation is very different, with four of the top ten beet producing countries in the world within the EU 25:

World sugar consumption has been steadily rising over recent years, in particular in the developing world where population levels are also rising. However the rise in consumption has been outstripped by the rise in production, resulting in a surplus of sugar on the world market and low prices. There are around 16m tonnes of sugar in store world-wide, representing 12-13% of the current world annual consumption of around 130m tonnes. This situation is unlikely to change significantly in the foreseeable future. Whilst not publicly acknowledged, the recent accumulation of sugar intervention stocks in Europe is likely to have been a catalyst to abolish intervention as part of the recent reforms to European sugar policy.

The world market for sugar represents 20% to 30%² of the sugar traded internationally, with exports dominated by Brazil (12.5 m tonnes in 1999, out of total world exports of 39.5 m tonnes)³ followed by the EU (5.1 m tonnes, of which about 2.8 million tonnes was quota sugar and the remainder non-quota or 'C' sugar which receives no refund payments).

The 'world market' for sugar is portrayed as a volatile residual market⁴ where prices seldom bear any relation to normal production costs. For the majority of the time, world market prices are depressed, and often below even the most efficient industries production costs. This is principally because many agricultural regimes around the world support their sugar sectors meaning the world 'market' bears little resemblance to a market at all but is in effect a 'dumping ground' for surplus sugar produced outside the main global supported sugar sectors. It is for this reason it is difficult to predict what the market price would be for sugar on a genuinely free world market.

Prior to the 2005 reforms, EU sugar prices were set at about three times current world market levels, although in the view of British Sugar this is misleading since recorded prices on the residual world market are unrepresentative of actual production costs.

When Britain entered the EEC in 1973 it was anxious to protect the status of its former colonies that had enjoyed favourable market access under the CSA. Under the Sugar Protocol to the African Caribbean Pacific (ACP) Lome Convention, (succeeded in 2000 by the Cotonou Agreement) the EU undertook to purchase and import at guaranteed prices (and free of import levies) cane sugar originating in certain named ACP states as well as India. Total ACP preferential cane sugar quotas come to just over 1.3 million tonnes. The refining of most ACP and EBA sugar (about 1.1 million tones) is still undertaken in the UK by Tate & Lyle.

2. British Sugar places this at 20%, the Commission in its impact studies at 30%.

3. International Sugar Union (million tonnes raw sugar value).

4. This British Sugar view is disputed by others.

Sugar Policy

The Development of the EU Sugar Regime

The European Union Sugar Regime was established in 1968 (Commission, 1967) aiming to "ensure fair incomes and self-sufficiency among EU producers" (Commission, 2005a).

Although subject to numerous 'tweaks' it largely remained unreformed until 2005, comprising six key features:

- i. Administrative establishment of prices – an intervention price, a beet price and a white sugar price
- ii. Quota limits on production
- iii. Production levies, which rather exceptionally for the CAP have meant the scheme has been largely self financing to date
- iv. Stock carry over and storage costs
- v. An import regime
- vi. An export regime

(Mark, 2006)

The sugar regime 'quota' system limits the quantity of sugar that receives the benefit of price support. Until the 2005 reforms were implemented, the sugar regime had the following elements:

The intervention price at which intervention agencies were obliged to buy in eligible sugar. By 2004 this had been frozen since 1984/85 at €631.90 per tonne for white sugar and €523.70 per tonne for raw sugar, intended as a 'safety net' guaranteeing a minimum price for sugar. Import duties and restriction of available quantities generally kept market prices above the level of intervention.

The minimum price is the price at which sugar manufacturers were required to buy beet from growers. It was set by the Council at € 46.72 per tonne for the A beet used to produce A quota sugar and € 32.42 per tonne for the B beet used to produce B quota sugar. The prices up to the end of the 2005/06 marketing year (the last year of the old regime) were unchanged since 1993/94.

The Community prices were (and still are) guaranteed only for production within quotas. The total quota amount of 14.5 million tonnes for the old EU 15 split into A quotas (82 %) and B quotas (18%) set per Member State. These A and B quotas corresponded in principle to the demand on the internal market, and to the export of excess quota sugar with export refunds, respectively. For sugar produced outside the quotas there was no support, nor could it be freely marketed within the Community. The extra quantities were 'carried over' to the next marketing year or exported as they were without refund. The 'carryover' involved storage of the surplus for a minimum period of 12 months, following which it was treated as A sugar produced by the plant as part of that year's

production. The sugar produced outside the quota that was not carried over must have been exported without refund, and was called C sugar.

Export refunds were intended to cover the difference between the Community price and the world price for sugar, allowing it to be sold on the world market. The average export price for white Community sugar was €280 per tonne for the 2001/2002 marketing year. Refunds were paid for sugar obtained from beet or cane harvested in the Community and sugar imported under the ACP Protocol/Agreement with India. As an example, for the marketing year 2001/02 refunds were €443 per tonne and for 2002/03 €485 per tonne.

In the UK, beet sugar production is limited to around 1.14 million tonnes (varying slightly from year to year), about half domestic consumption levels. Non quota or “C” sugar may not be sold within the EU and is exported without export refunds at prevailing world prices. The cost to the EU budget of exporting surplus quota sugar is met by a system of levies on the industry.

The introduction of duty free imports from 49 Least Developed Countries (outside the ACP Sugar Protocol) into the EU from 2006 under the Everything But Arms Agreement will have a significant impact on the sugar regime. The duty free quota under the EBA will gradually increase until full liberalisation in 2009. EBA has been another catalyst for policy reform.

An International Perspective

Although widely criticised, the European Union was not the only one playing the 'protectionist' game. The United States is little different from the EU in operating a protectionist regime. As Mark (2006) notes, the US sugar programme was established by the Food and Agriculture Act of 1981 and has been tweaked many times, with the core policies being loan programmes and import restrictions. The main purpose of the loan programme is to provide market support by allowing processors to store the sugar rather than sell it at lower than desired prices.

Drivers for Reform

Some drivers for reform have already been mentioned. According to official EU documents (Commission 2005) there were four reasons for reforming the sugar sector:

- i. The maintenance of prices three times the world market price was viewed as simply unsustainable;
- ii. The need for compliance with the World Trade Organisation (WTO) - Long criticism had been levelled at the EU and the operation of her sugar regime although as Swinbank (2004) notes, much of this was not justified. However, the ruling by the WTO Appellate Body in 2004/05 (WTO, 2005) was the final nail in the coffin for the existing regime.
- iii. The previous regime ended on 30 June 2006 anyway i.e. doing nothing was not an option.

- iv. Prolonging the current system was not seen to be an option, given the decoupling of aids already introduced to the arable, livestock and Mediterranean sectors.

The Commission first brought forward proposals for reform announced in September/October 2003 and in July 2004 they published a further paper setting out their preferred approach in the light of the political debate and other reactions to the September 2003 paper. This was itself discussed in the Agriculture and Fisheries Council, which in November 2004 agreed with the Commission's analysis that the existing regime would not provide a viable future for sugar production in the EU without substantive change.

The Commission decided, however, that it would not bring forward formal legislative proposals until after the outcome of the World Trade Organisation challenge to the existing EU sugar export arrangements, which proved to be one of the major catalysts for reform as noted above. Indeed, the Commission made a statement at the time accepting that a reformed regime would have to comply with these findings.

The formal proposals were finally released on 22 June 2005 (Commission, 2005b) although these had been widely leaked in the press in the weeks leading up to Mrs Fischer Boel's speech (Fischer Boel, 2005b) to the European Parliament.

Details of the 2005 Reform Agreement

As so often with CAP reform debates, the agreement was a "Presidency Compromise" (Council, 2005) which saw a number of changes to the original Commission proposal. At the time the Council was keen to stress that this "general approach on Sugar Reform was agreed without prejudice to the opinion of the European Parliament (EP)" although in reality all the parliament could do was "rubber stamp" the proposals when they were discussed at the EP Plenary on 17 January 2006.

As a reminder, the reform package comprises three separate Regulations which are:

- Reform to the Common Market Organisation in Sugar which will apply from the beginning of the marketing year 2006/2007. Prices, quota production, out-of-quota production and market management now apply until the marketing year 2014/2015⁵.
- Amendment to Council Regulation 1782/2003 (the Luxembourg Agreement of 2003) which applied from 1 January 2006, integrating sugar into the single payment scheme framework;
- A Temporary Scheme for Restructuring of the sugar industry – which applies from the beginning of the marketing year 2006/07.

5. It should be noted that as part of the separate CAP simplification process, the Commission is now proposing a single CMO in papers which are expected to be released early in 2007.

Table 2. Summary of price levels and support figures under sugar reform (in €/tonne)

	Now	2006/07	2007/08	2008/09	2009/10
Minimum sugar beet price (€/t)	43.63	32.90	29.80	26.70	26.30
% reduction		24.7%	31.7%	38.8%	39.5%
Raw Sugar Price (€/t)	523.70	496.80	496.80	434.10	335.20
% reduction		5%	5%	17.1%	36%
Support Price (€/t)	631.90	631.90	631.90	524.00	404.40
% reduction		0%	0%	17.1%	36%
Restructuring Levy	0	126.40	173.80	113.30	0
Net Reference Price (€/t)	631.90	505.50	458.10	410.70	404.40
% reduction		20%	27.5%	35%	36%
Restructuring Aid	0	730	730	625	520
Regional diversification (new)		109.5	109.5	93.8	78
Direct Aid m €	0	907m	1178m	1499m	1542m

Price Cuts

A 36% sugar price cut is being spread over four years, instead of the 39% price cut over two years originally proposed by the Commission. There is a 39.5% sugar beet price cut spread over four years (instead of 42.6% over two years). In 2009/2010, this takes the minimum beet price to €26.30/tonne (£17.88 at 68p, £17.35 at 66p).

Market Measures

As already mentioned, the Regime is scheduled to run until 2014/15 with no review.⁶

The existing intervention price has been replaced by a reference price and by a private storage mechanism. However during the transitional period of four years (2006/07 to 2009/10), an intervention price is set at 80% of the reference price of the following year for a maximum quantity of 600,000 tonnes per year of white sugar.

In 2010 a private storage system will be introduced which will operate if the market price falls below the reference price.

Production Quotas

'A' and 'B' quotas have been merged into a single production quota.⁷

To maintain a certain level of production in the current 'C' sugar producing countries, an additional 1 million tonnes of Quota has been made available against a one-off payment corresponding to the amount of

6. It is widely agreed that in 2014/15 Milk Quotas will be abolished with "preparation" for this beginning in the CAP Health Check of 2008/09. Surely if Sugar Quotas are also to be abolished in 2014/15 (as some have suggested) then there will need to be a "mid term review" or "Health Check" of the sugar regime prior to 2014/15?

7. This effectively disadvantages the UK, who has had a very small B Quota relative to A Quota historically.

restructuring aid per tonne in the first year.⁸ There are also increases in isoglucose quota.⁹

Non food sugar can be grown on set-aside land, and sugar for energy can receive the 45 €/ha Energy premium, with bioethanol and biobutanol sugar exempt from production quotas.

Compensation

Original EU 15 Countries

There is compensation paid for the price cut a level slightly above 64% of the cuts. This aid is included within the single payment scheme and will thus be linked to environmental and land management standards.

The payment is 100% decoupled, which the UK pushed very hard for from very early on in the negotiations (see, for example, House of Commons (2005) who strongly recommended this). However, during a transitional period of up to five years for Member States reducing their quota by more than 50%, a temporary adjustment coupled aid may be granted under the European Agricultural Guidance and Guarantee Fund (EAGGF) Guarantee Section, corresponding to a maximum of a further 30% of the revenue loss, on top of the 64% covered by decoupled compensation payment.

Member States will have flexibility in allocating direct aid according to objective criteria although as widely predicted in most cases it has had to follow the main single payment model used for the arable and livestock regimes. In the UK, intense lobbying from the NFU allowed some "ring fencing" of a relatively small proportion of the aid to sugar beet producers specifically until 2010, but the majority of the payment goes into the progressive flat rate "pot"; by 2012 this adds about £3/acre to the Lowland England Non-SDA SPS Payment.

Central European 10 Countries

For the 10 Central European Countries, who joined the European Union on 1 May 2004, there is the introduction of a Separate Sugar Payment (SSP) as an alternative to the Single Area Payment Scheme (SAPS). A new Member State has the possibility to opt for the SAPS non-specialised payment to add national top-ups to provide incentives in regional areas or specific production or to opt for the SSP to be granted only to beet growers without the possibility of national top ups. Although SAPS itself is a transitional payment for the New Member States who will eventually convert to the Single Payment Scheme model applicable to the old EU 15 since 2003, the recent extension to SAPS (albeit with cross compliance and the coupled aids attached) adds weight to those who suggest that the Commission see a fully area based land management payment as the replacement for SPS post 2012.¹⁰

8. In addition, quota of 10,000 tonnes per Member State is allocated to Greece, Spain, Ireland, Italy, Latvia, Hungary, Poland, Slovenia, Slovakia and Finland against a one-off payment corresponding to the amount of restructuring aid per tonne in the first year.

9. Increases of 300,000 tonnes per existing Producer Company phased in over three years, with additional Quota allocated by Italy, Lithuania and Sweden subject to one-off payments. The EU 25 isoglucose Quota is 507,680 tonnes.

10. In effect given that 8 out of the 10 states who joined in 2004 have area based payments, plus England and Germany which have both chosen to move to flat rate aids, this would only be a major change to those countries which adopted the historic system.

Restructuring

There is a voluntary restructuring scheme, lasting four years, for EU sugar factories, and isoglucose and inulin syrup producers, to encourage total factory closure and renunciation of quota, as well as to cope with the social and environmental impact of the Restructuring process. The Commission will be present a report on the working of the Restructuring Fund by the end of 2008.¹¹

The payment is €730/tonne of white sugar renounced in year one and two, falling to €625/tonne in year three and €520/tonne in the final year.

This restructuring aid is financed by a degressive levy on holders of quotas, through the restructuring amount – production levy - €126.4/t in the first year, €173.8/t in the second year and €113.3/t in the third year.

Greater flexibility is also added with regard to eligibility for restructuring aid – at a lower percentage – including the case of partial dismantling of a factory and continued use of the production site, excluding products covered by CMO Sugar (75%), partial renouncing of sugar quota and continued use of the facility for products covered by the CMO Sugar with the exception of refining raw sugar (35%).

Regional diversification: 15% of the restructuring aid for each marketing year is earmarked for regions affected by the restructuring process. A number of special deals were also negotiated by individual Member States.¹²

Table 3. Single Payment Scheme Budget for Sugar Compensation

€ MILLION	In 2006/07	By 2009/10
Belgium	49	84
Denmark	19	34
Germany	155	278
Greece	18	29
Spain	60	96
France (mainland)	151	270
Ireland	11	18
Italy	80	136
Netherlands	42	74
Austria	19	33
Portugal (mainland)	4	6
Finland	8	14
Sweden	21	34
UK	64	105
Czech Republic	28	44
Hungary	25	40
Latvia	4	7
Lithuania	7	10
Poland	99	159
Slovakia	12	19
Slovenia	3	5
France (DOM)	27	44
Portugal (Azores)		1
TOTAL	907	1542

11. It is estimated this will reduce production by around 6 million tonnes over four years.

12. €9M for Austria to help with investment in collection centres and €5M for the Swedish region of Gotland. Portugal is to be allowed to convert its sole beet factory to cane production and Finland given flexibility to pay top up payments to growers supplying its sole factory.

Budget

The budget foreseen for the sugar sector in 2004 represented €1,721 million made up for the most part of Export Refunds (75% of the total). The new compensation payment budget is €1,542 million from 2009/10 which is allocated as follows.

Clearly some of this decoupled payment is “new money for farmers” saved from within the sugar regime itself, but any shortfall will have to be taken via Financial Discipline of the other sectors, given the overall ceiling on CAP spending which remains in place and which was agreed by Chirac and Schröder in 2002. The official line of the Commission is the reform is “budget neutral” as the costs of the new measures, notably the compensation of the sugar beet farmers will be off-set mainly by savings resulting from a substantial reduction in export subsidies (Commission, 2006).

The full compensation payment equates to about €11.90/tonne or about £430/ha (£174/acre) by 2009/10, phasing up gradually from £250/ha (£101/acre) in 2006/07.

ACP Sugar

The ACP Protocol is maintained under the reform arrangement, with money made available to ease the transition. Critics, however, have pointed out that the compensation of €40 million proposed for 2006 is a drop in the ocean compared to the money made available to compensate European beet growers (see, for example, BBC 2005).

General Reactions

Mrs Fischer Boel (2005c) stated she was “delighted with this historic agreement and thanked the British Presidency for their skill, hard work and excellent co-operation.” Other reactions were not so positive:

The International Confederation of European Beetgrowers (CIBE) stated that roughly eighty sugar factories across the EU would have to close, affecting some 120,000 beet producers

The Umbrella organisation of farming unions and co-operatives COPA and COEGA described the reform as “too drastic” despite “some improvements”

Sugar users, represented by CUIS, were highly critical of the dilution of the price cut, which would “seriously harm competitiveness in the immediate future.” There is also concern that the considerable increase in the restructuring levy will have to be paid for by consumers and sugar users.

The value of Tate and Lyle’s shares, Europe’s biggest cane sugar refiner, leapt by 5% on the announcement of the reform package as the price cuts were diluted from those first proposed.

The ACP countries spokesman said that the reform “sends a message of doom to the small and poor sugar cane farmers and workers.” The main sugar importers under the ACP arrangement to the EU are Mauritius (489,000 tonnes), Fiji (204,000 tonnes), Guyana (195,000), Swaziland (169,000) and Jamaica (150,000 tonnes).

EBA sugar imports rose to 120,000 tonnes in 2001/02 with Sudan and Mozambique the two main beneficiaries of this arrangement. The quota reaches 197,334 tonnes by 2008/09 with tariffs being completely suspended on

1 July 2009.

"It is about as bad as it could be", said Adam Harrison of WWF in a joint press release with Oxfam, which added that the deal is the worst possible result for developing countries and the environment.

The EU acknowledges that sugar reform will "reduce the expected returns to LDCs and Sugar Protocol countries..... but sending sugar to the EU should still be attractive for a number (of countries)..."

Implications for the UK Sugar Industry

The Reform of the Sugar Regime at European Level was followed by a new Inter-Professional Agreement (IPA) between British Sugar and the National Farmers Union (NFU) covering the period 2007-2009. This followed an announcement by British Sugar that it would be closing its operations at York and Allscott, focussing production on four sites: Newark; Cantley; Wissington and Bury St Edmunds.

There was much talk in the farming press and elsewhere that if British Sugar paid only the minimum beet price (about £17.50/tonne by 2009/10) then few would grow the crop in the UK. This theory looks unlikely to be tested in the short term, as the NFU secured a beet price slightly above the minimum price set out in the European regulations of between £19 and £20 per tonne (with a small link to the wheat price) by 2009.

For the most efficient UK farming businesses this squeezes the profitability of sugar beet to a similar magnitude to many combinable commodities with production costs anywhere between £15 and £25 per tonne for most businesses although for the most efficient sugar beet producers it still remains the break crop of choice, outperforming oilseed rape at both the gross margin and full cost per tonne level. Simplistic analysis of individual enterprises also of course fails to take into account the 'contribution to overheads' made by marginal crops and the fact that many farmers are better off producing marginal crops rather than fallow because of sunk costs which cannot be scaled back. For most sugar beet growers, who employ specialist contractors to harvest the crop and outside hauliers to take the crop to the factory, their own specialist capital investment is limited and thus they could probably choose to substitute an alternative enterprise with relative ease, with for many the issues of combine capacity, limited grain storage or rotational flexibility the reasons for continuing with marginal sugar beet crops.

However, cropping patterns are undoubtedly likely to change. The ability to trade and lease quota on an annual basis being the most critical. Could the most shrewd farmers "max out" on sugar beet in a low combinable commodity year, effectively then leasing out (even if for a negative charge) their beet contract when wheat and rape prices rise. Effectively on the better land sugar beet competes with wheat and oilseed rape in high commodity price years and with set-aside, fallow or environmental schemes in low price years. There are of course many practical issues; for example how easy will it be to "switch on" and "switch off" beet contractors?

So who will grow sugar beet? Production on heavy clay soils may fall due to the removal of the early delivery bonus (EDB) and the need for early harvest on these soils which results in an effective penalty on adjusted

tonnages due to low sugars. Renwick et al (2005a; 2005b) note that these highest cost producing farmers are likely to be those who quit the industry. Similarly there will be a reduction in production on droughty light soils where the crop competes against fallow and environmental schemes (and of course vegetable letting for those who have water). The issue of sugar beet performance in relative terms in the rotation becomes much more pertinent. There may be increases in production on silts and well bodied loams that can reach 70 t/ha adjusted yields, and there is inevitably likely to be polarisation around the factories.

Key change areas are obviously the West Midlands and Vale of York (most of the North Lincolnshire and South Yorkshire sugar beet simply gets re-directed from York to Newark since many growers were equidistant between the two factories) but also North West Norfolk – mainly because sugar beet has been the mainstay of farm profitability on this light land for many years. Sugar beet reform may be a catalyst for wider business restructuring.

Mathematical modelling of farmer behaviour in a decoupled environment is almost pointless: aside from the inertia and irrationality than exists within the industry it is more useful to look at scenario planning to predict the medium term possibilities for the industry. However some very simplistic extrapolation of current areas can be undertaken. Reducing overproduction from 15% to 10% (as British Sugar suggests) or to 5% (as the author suggests is more realistic) takes the area grown to under 150,000 ha. If we assume yield increases of 10% then the areas grown fall to about 135,000 ha and 141,000 ha respectively. If everyone achieves the target 70 t/ha (acknowledging this is a tall order for some) then the area could stabilise at about 115,000 to 120,000 ha.

It is worth reflecting on the current supply chain structure. The monopoly processor position currently means that there must be a single organisation representing beet growers (as set out by law). There has been talk about producer groups forming and representing themselves, but in the current legal and political environment this looks difficult. However, for the largest and most efficient producers there could be supply chain benefits from breaking away as at the moment the largest growers pay for the supply chain costs and inefficiencies (from a large number of transaction points with small growers) through the single pricing structure. Can one organisation genuinely represent the interests of all growers? Probably not. However, change will be difficult - Turkeys very rarely vote for Christmas!

But what are the implications of the current structure? Unless an organisation like British Sugar is genuinely allowed to sort out and rationalise its supply base in the most economically optimal way, like many of the packing and processing companies in the fresh produce sector have (particularly potatoes), then can the growers expect British Sugar to show all of their cards and work together in a totally co-operative way to genuinely improve supply chain efficiency? If constraints continue within Europe then will British Sugar continue to look further afield to source product (raw or refined) without the constraints placed on it by European Union bureaucracy? The long term removal of production quotas for sucrose (as already mentioned a possible option after 2014/15), whilst freeing up restrictions within Europe

will also lead to the removal of quotas for other sweeteners (most notably isoglucose). By 2020, who knows how the relative performance of components of the sweeteners market will have evolved, or indeed how consumers' appetite for sweeteners and sugar products will have changed?

It is worth taking a moment to reflect on the long term future of the UK sugar beet industry in context. On the day of the announcement, the official ABF press release stated that “these proposals are welcomed by British Sugar as one of the most efficient producers in the EU. The main elements of the June proposal are retained in this agreement but are phased in over a longer time and additional funds are made available for industry restructuring” (ABF, 2005)

But what is ABF's strategic positioning? Ultimately they are retaining a balanced portfolio – whilst retaining their commitment to UK sugar beet production (the purchasing of 83,000 tonnes of additional quota will take the output of the remaining four factories to be greater than the previous six) they have also expanded the operations of British Sugar Overseas (BSO) with the consolidation of their Polish Factories from four to two and the purchase of an additional 11,000 tonnes of sugar quota in Poland. This should re-inforce British Sugar's position as one of the lowest cost producers in Europe, and their collaboration with BP and Du Pont for the production of biobutanol adds again to their strategic portfolio by ensuring industrial as well as feed markets are covered.

One of the most interesting developments of the past year or so is the purchase of a 51% stake in Illovo sugar by ABF. This 'fits' well from a number of perspectives:

- Illovo is set to benefit from British Sugar's expertise in production operations, development, marketing and innovation;
- Illovo will benefit from free access for imports of sugar to the EU from the LDC countries from 2009;
- British Sugar can provide efficient routes to EU markets for Illovo sugar
- Use of Illovo's cane sugar operations will assist the future of BSO's Chinese operations (also sugar cane)

Illovo probably isn't a threat to British Sugar in the short term; but it is after 2009. The EU is set to become a net importer of sugar; Commission sources suggest a 105% increase in imports from 1.9 million tonnes to 3.9 million tonnes (put in context domestic production is forecast to fall by 39%) and Illovo is likely to take part of this new market share. Both businesses are competitive in differing and complementary markets: but beet processing will need to remain viable in the UK if ABF are to stick with domestically produced sugar beet.

The other question often asked: is biofuel a threat to the food sugar industry. At £11/tonne beet production for biofuel does not stack up, except for removing surpluses; this price is significantly below cost of production for

even the most efficient growers. Production from cereals is likely to be economically more viable and it is likely ABF are keeping their options open on choice of substrate for future biofuel investments.

Conclusions

This paper has covered a lot of ground but the conclusions can be summed up in five key messages:

- i. The Sugar Reform deal of 2005 will have a major impact on sugar production in Europe. For UK arable farmers who grow sugar beet, the effects of the price cuts are more significant than the MTR reforms to the arable regime in 2003. Beet producers are likely to get larger and more specialist.
- ii. The UK Sugar Industry is competitive certainly within a European context but the threat from cane sugar is likely to increase, especially after the full implementation of EBA in 2009.
- iii. ABF and British Sugar are hedging their bets – Beet & Cane; Geographically Balanced (UK, Poland, China, Africa); Developing New Markets (e.g. Biobutanol) as well as retaining existing markets
- iv. There are issues about the representation of beet growers and whether the current structure will ever deliver the most efficient supply chain – and if the supply chain is not allowed to become efficient will it be in the interests of the domestic industry long term (if significant processing capacity is transferred overseas).
- v. Cropping will become more flexible, and the ability to trade and lease quota annually will see much bigger swings in sugar beet cropping patterns than have ever been known before.

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Biographical notes

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Carl takes an active interest in the UK sugar industry working in East Anglia with a number of large producers and other stakeholders. The above article is a slightly edited version of the Sir Thomas Middleton Memorial Lecture, presented at the National Farm Management Conference in November 2006.

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CONFERENCE PAPER

THE CHALLENGE OF BIOFUELS

M. C. Bennett

The challenge of biofuels covers a wide range of opportunities and risks, competitors and constraints. This paper is concerned primarily with road transport biofuels (ethanol and rape methyl ester - RME), and reviews the factors which might affect the viability of UK biofuel industries. The 3 criteria are cost, energy balance, and greenhouse gas reduction. The opportunities are presented with reference to the enormous market potential, the EU and UK governmental targets, and the selling prices which must be achieved if biofuels are to compete with conventional fossil fuels, and with imported tropical products.

The opportunity for biofuels in the UK

With the growing economic need for secure alternative energy sources, and the environmental need to reduce CO₂ emissions, the importance of biofuels cannot be over-stated. A century ago, British agriculture was the main source of road transport fuels, in the form of hay and oats, and the opportunity exists today to re-establish a small but significant part of that market, which today amounts to some 40 Mt/a. Table 1 shows that in the UK, a quarter of the total *end-use* energy consumed is in the form of petrol and diesel motor fuels, and exceeds by some 37% the energy content of the total industrial and domestic electricity used (Dti 2005).

Table 1: UK energy end-use

	GW/ha	Per cent of total
Gas	660,000	36
Petrol and diesel	463,000	25
Electricity	337,000	18
Other petroleum	321,000	17
Other	56,000	4
UK total	1,837,000	100

There are very few practical alternative energy sources for road transport motor fuels. Liquid or compressed hydrogen must be seen as the most important competitor to biofuels because it is an excellent fuel, having an energy content of 120MJ/kg, nearly 3 times that of fossil fuels, and producing only water when burned. It is probably the fuel of the future for planes and ships, but it does have serious shortcomings for small scale use. Liquid hydrogen must be stored at -253⁰C and 200 bar, and compressed gaseous

1. This paper was presented at the UK National Farm Management Conference held at Basingstoke, 15 and 16 November 2006.

hydrogen is just as difficult to handle: hydrogen is highly explosive which makes it impractical and unsafe for many applications. In contrast, biofuels like ethanol and RME are proven, safe and convenient, and they are already widely used in many countries. As crude oil prices continue to rise, biofuels will become competitive: ethanol motor fuel made from sugar cane in Brazil is already much cheaper than petrol on a pre-tax, cost per mile basis.

Critical factors concerning biofuel programmes

The 3 critical factors which must be assessed when considering a biofuel programme are cost, energy balance and CO₂ emission; these will be considered separately as follows.

Cost

This must take into account the difference between the useful energy content (e.g. miles per gallon) of the biofuel and that of the fossil fuel it is to replace (Woods and Bauen 2003). For example, petrol has a Net Calorific Value of 44MJ/kg while ethanol has a Net Calorific Value of 27 MJ/kg only 61% that of petrol. But because ethanol is an oxygenate, and, when blended with petrol, improves the performance of petrol engines, the useful energy content of ethanol is put at 65% that of petrol: in Brazil, the pump price of ethanol was originally limited to a maximum of 65% that of petrol and today sells at about half the petrol price. RME, being an ester, contains 11% oxygen, and its Net Calorific Value, at 37MJ/kg, is 87% that of fossil diesel. However, the oxygen content is believed to assist a more complete combustion of the fuel, and the useful energy in RME biodiesel is put at 90% that of fossil diesel.

In Table 2, the costs at which ethanol and biodiesel could compete with fossil fuels are shown over a range of crude oil prices. It will be seen that at the current crude oil price around US\$60/bl (21 p/l in Sterling); ethanol must be available for less than 20 p/l and RME for less than 27p/l. HM Dept. of Revenue and Customs provides a tax rebate of 20p/l on all biofuels, which raises the competitive pre-tax selling prices to 40 p/l and 47 p/l respectively.

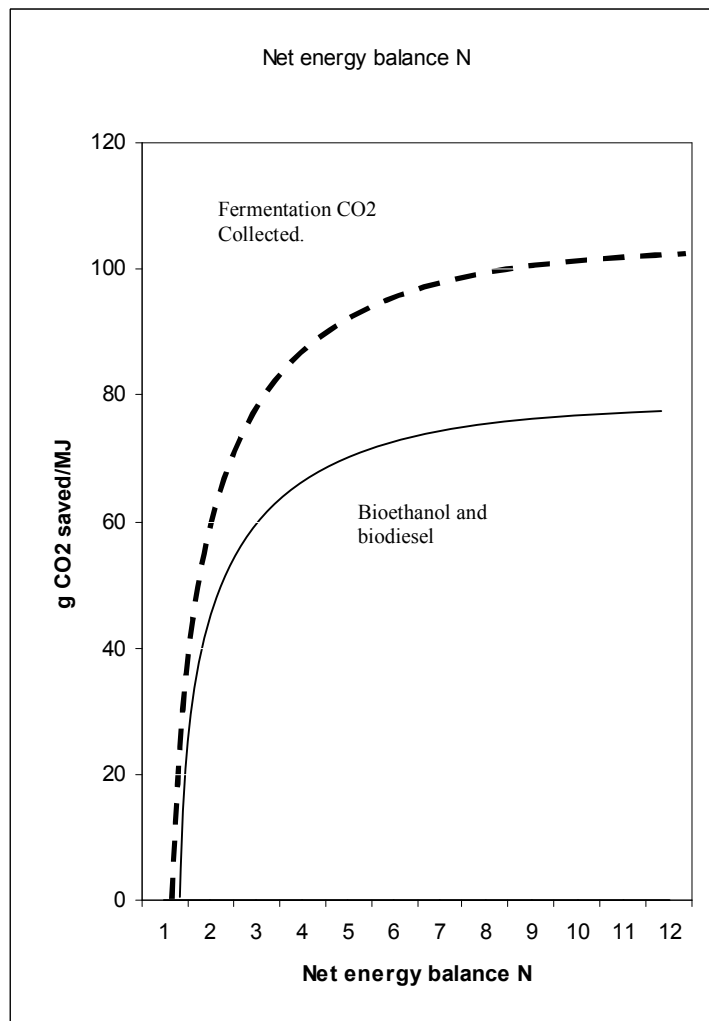
Table 2: Biofuel competitive cost

Crude oil		Petrol/diesel	Biofuels	
		p/l	p/l to compete	
US\$/bl (1bl = 159 l)	p/l (£1 = \$1.8)		Bioethanol 65%	Biodiesel 90%
30	10.5	18	12	16
40	14	22	14.5	20
50	17.5	26	17	23.5
60	21	30	20	27
70	24.5	35	23	31.5
80	28	40	26	36

Energy Balance

The Energy Balance has been defined as the amount of biofuel energy produced per unit of direct non-renewable energy input (Woods and Bauen 2003). The energy input is determined by a Life Cycle Analysis (LCA), in which all of the energy inputs made in producing the crop, transporting it and processing it to fuel should be included. The Energy Balance is described here by the factor N , where $N > 1$ for a net energy gain. The value of N for Brazilian ethanol made by the fermentation of sucrose from sugar cane is put around 10 (i.e. 10 times more energy is available in the product than is spent in making it), while for European ethanol made from sugar beet, N is much smaller, around 1.4 – 2.1. Ethanol from wheat shows N varying from 0.7 to 2.7 (Woods and Bauen 2003). RME biodiesel produced from rapeseed oil is reported to show values for N between 0.7 and 4.4 (Woods and Bauen 2003). However, a recent study reports the delivered factory gate energy balance for UK crops to be more favourable: sugar beet 7.3-15, winter wheat 6-13 and oilseed rape 7-8 (Tzilivakis, Warner *et al* 2005).

Figure 1. Reduction of CO₂ emission from biofuels.



The energy balance for hydrogen fuels made by electrolysis is considerably less favourable, since it takes 1.5MJ of electricity to make 1MJ of hydrogen, and up to a further 0.3 MJ to liquefy or compress it to a transportable road fuel. Even for “renewable” electricity, the comparative N value is about 0.5, which indicates that hydrogen can only become a realistic competitor when very cheap electricity is available.

CO₂ Emission.

The CO₂ emitted by combustion of the biofuel is not taken into account because the CO₂ originated in the atmosphere and is regarded as being recycled by photosynthesis. The base line is therefore set by the fossil fuel replaced by the biofuel: every tonne of oil replaced by a biofuel effectively saves 3.5t of CO₂. Against this must be set the amount of CO₂ emitted in producing the biofuel and, once again, an LCA is necessary to establish the complete picture. Just as there should be a net energy gain ($N > 1$), the CO₂ emission should show a net saving: Figure 1 shows a relationship between the reduction in CO₂ emission and the energy gain factor N referred to above. A mean value of 85g CO₂/ MJ fossil fuel has been taken, and the solid line graph represents the saving in CO₂ as $85 - 85/N$ g CO₂/MJ biofuel (Woods and Bauen 2003). At $N = 10$, Brazilian bioethanol shows a 95% reduction in the CO₂ emission; ethanol from European beet sugar (at $N = 2$) would show a reduction of 50%.

However, when sucrose is fermented to ethanol, just under 1 t of CO₂ is produced for every t of ethanol, and if this were trapped and prevented from escaping to atmosphere (CCS carbon capture and storage), the potential reduction in CO₂ emission is increased from 85g CO₂ /MJ to 120g CO₂ /MJ ethanol, as shown by the dashed line in Figure 1. For ethanol made in the UK from beet, $N = 2$, and the CO₂ saving is doubled; for ethanol made from cane where $N = 10$, there is a net reduction of atmospheric CO₂. In the context of UK Governmental policy on biofuels, which has hitherto been determined to a great extent by its Kyoto commitment, this opportunity to almost double the beneficial impact of bioethanol on greenhouse gas emissions seems to have been overlooked.

Governmental biofuel targets

The 2003 EU Council Directive on biofuel use targets is compared in Table 3 with UK's Renewable Transport Fuel Obligation (RTFO) which was set only in November 2005. The EU targets are based on energy content while the UK RTFO is based on volume: the two sets may be compared only by using the volumetric net calorific values² for the fuels concerned, as listed below.

Petrol	2.95 MJ/l	Ethanol	21.28MJ/l	95/5 v/v/mixture	32.37 MJ/l
Diesel	35.71 MJ/l	RME	32.80 MJ/l	95/5 v/v/mixture	35.56 MJ/l

The UK 2010-11 target of 5% v/v for petrol (equivalent to 3.29 % by energy content) is nowhere near EU target, but for diesel, the targets are closer, 5% v/v being equivalent to 4.6% by energy. Both sets of targets are achievable without any major impact on the user, and no modification of

Table 3: EU and UK biofuel targets

2003 EU Council Directive	% by energy content of motor fuel
2005	2
2010	5.75
2020	8
UK Government RTFO	% v/v of motor fuel
2008-9	2.5
2009-10	3.75
2010-11	5

RTFO UK ethanol: 5% v/v = 3.29% by energy

RTFO UK biodiesel: 5% v/v = 4.6% by energy

engine components will be required. The fuel manufacturing and distribution industries could encounter problems, as will be discussed below.

The 5% v/v UK targets amount to some 15 Mhl/a (or 1.2 Mt/a) of ethanol and 10.5 Mhl/a (or 0.8Mt/a) of RME. If these quantities are to be produced from home grown crops, the impact on British agriculture would be very great indeed. Nearly 1M ha of land would be needed to grow these crops as shown in Table 4 where the ethanol figures are based on yields of 4.5t/ha from beet and 2.25t/ha from wheat, together with a crop rotation of 2 years of cereal followed by 1 year of beet: the RME yield is put at 1.4 t/ha but the oilseed rape crop is not included in this rotation. It may be noted that the current area of “set-aside” land in the UK is around 550,000ha, so all of this, and as much again, will need to be brought into cultivation if the biofuel targets are to be met from home-grown British crops. An EEDA Report presents an excellent analysis of suitable land availability (EEDA 2003).

Table 4: Projected area of UK land required to achieve 2010 target

Ethanol 1.2 Mt/a	hectares	increase
Beet area	125,000	(+ 100%)
Wheat area	250,000	(+ 15%)
<i>Total ethanol area</i>	<i>375,000</i>	
Biodiesel 0.8 Mt/a		
<i>Total oil crop area</i>	<i>600,000</i>	<i>(+ 100%)</i>
Total area	975,000	

Table 4 relates to the 2010-11 RTFO which is a practical possibility, but it is important to point out that there is a limit to the UK production capacity. To replace all of the UK motor transport fuels completely with biofuels made from home grown crops is simply not possible. The bioethanol to replace all petrol would need over 11M ha of land and the RME to replace all diesel would need 13M ha, making a total of 24M ha, which is not available: the current total UK area of agricultural land is 18.5M ha of which 5.8M ha is

arable (Defra 2005). To be realistic, UK agriculture could only produce about 8-10% of the country's road transport fuels, in line with the EU Council Directive for 2020, but even this would revolutionise British farming. The infrastructural and environmental impact (roads, waste disposal etc) lie outside the scope of this paper.

Biodiesel

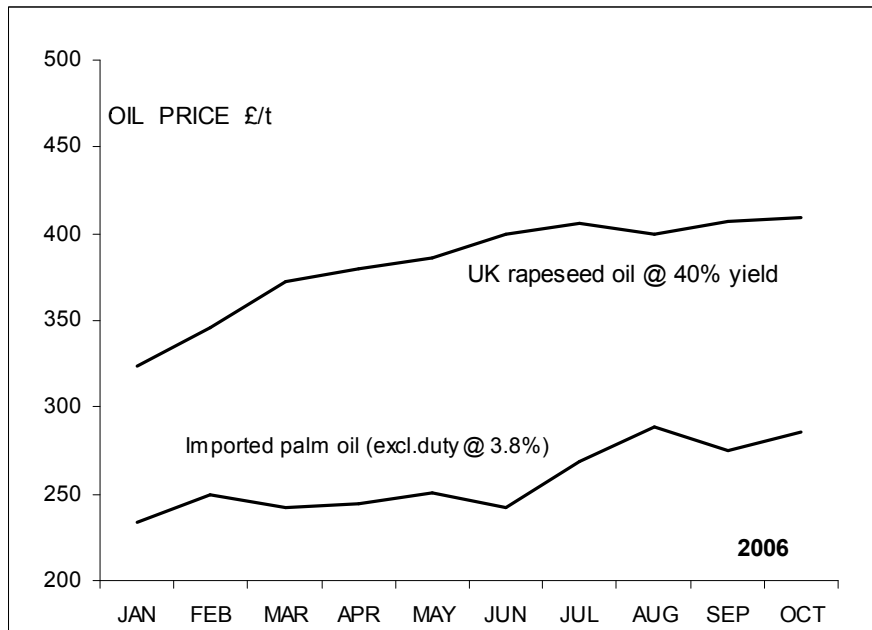
Biodiesel is made by a simple chemical process (methanol transesterification) from virtually any natural oil or fatty triglyceride, e.g. from palm oil, sunflower oil, coconut oil and even (in New Zealand) waste lamb fat: in the UK, attention is concentrated on rapeseed oil and RME (rape methyl ester).

As mentioned in Section 2, because biodiesel is not pure hydrocarbon, it has only 87% of the energy content of fossil diesel. Biodiesel with its predominantly hexadecyl (C_{16}) and octadecyl (C_{18}) hydrocarbon chains is apparently similar chemically to fossil diesel (often described by its C_{16} "Cetane No.") but there the similarity ends. The fatty acids of natural oils and fats are straight chains (like oleic and stearic acids) while fossil diesel is highly branched and does have different combustion characteristics. Biodiesel can be used on its own or mixed with fossil diesel without engine modification, but there are few reliable data on fuel economy.

At current rapeseed, methanol, caustic soda and manufacturing costs, and with the 20p/l tax incentive, RME can compete with fossil diesel so long as the crude oil price stays above the \$45/bl mark (see Table 2). The rise in crude oil price to over \$60/bl brought about a massive expansion of bioethanol manufacturing capacity in the UK, followed by some unfortunate business failures: the 250Kt/a plant under construction in Teesside has been delayed by under-estimation of capital costs, and Quality Control will have to be improved if the UK product is to match that of Germany where nearly 2 Mt/a is produced, and is tax-free. But there is a growing interest in small on-farm package biodiesel plants which could provide the farmer with his own supply of tractor fuel.

While the future for UK biodiesel does look promising, it must be recognised that the yield is low, around 1.4t of fuel/ha: there would appear to be considerable scope for crop-breeding improvements, better oil extraction technology, and utilisation of the high calorific value pulp. Furthermore, the greatest challenge to a UK RME industry is that imported palm oil is considerably cheaper than rapeseed oil, as shown in Figure 2 which compares recent CIF Rotterdam prices (in £/t @US\$1.8/£) of imported Crude Malaysia/Sumatra palm oil (excl.3.8% import duty) (The Public Ledger), with those of rapeseed oil (40% yield on OSR (Farmers Weekly Interactive 2006a). The saving in raw material cost is worth about 13 p/l on the RME price, and, if imported palm oil is to be widely used in the UK, the tax rebate of 20 p/l could be viewed as an incentive to the importer rather than to the British farmer. On the other hand, major producers of palm oil, like Malaysia, are setting up their own biodiesel industries and the price of their export palm oil is rising.

Figure 2: UK prices of imported palm oil and rapeseed oil.



Bioethanol

The challenges which face the development of a British bioethanol industry are considerably more complex than those relating to biodiesel. Although there is nothing new in the technology of either the manufacture or the use of ethanol, there is much room for improvement and simplification. The issues discussed here are:

- Comparative cost of imported raw cane sugar against the sugar in home-grown beets.
- Cost of ethanol production from beet and wheat, and the comparative cost of imported Brazilian ethanol.
- Co-production of sugar and ethanol at conventional beet factories, or stand-alone ethanol plants.
- The use of ethanol in motor fuel.
- Butanol as a biofuel.

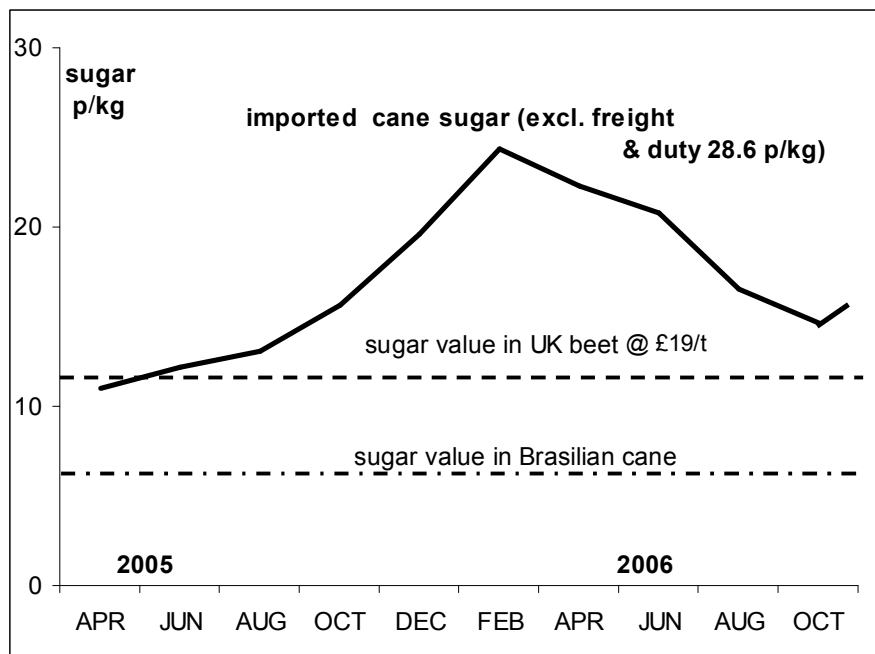
Cane vs. Beet for ethanol production

Under the reform of the EU Common Agricultural Policy, by 2009 changes to the sugar regime will allow cane sugar from the least developed countries to be exported freely into the EU. Sugar beet prices will fall to a level at which only the most efficient beet growers can survive, and the challenge arises: can the efficient European beet grower compete with imported sugar from the efficient cane growers in the tropics? Indeed, can a

UK beet-based ethanol industry compete with imported ethanol?

Figure 3 shows the world market price of cane sugar (New York #11 Contract price in US\$ cents/lb (f.o.b) recalculated in sterling p/kg @ \$1.8/£: World Association of Beet and Cane Growers (2006)) over the past 18 months: the high of 26 p/kg was a consequence of the sudden demand for ethanol in autumn 2005. UK import duty & safeguard, currently at €419/t, and freight etc would add a further 30 p/kg. Sugar beet prices in the UK are decreasing (this year to £22.86/t) and will fall to around £19/t. Figure 3 shows that, at this level, with a sugar content around 18%, the value of the sugar in the beet would be about 10.5 p/kg, which is not much more than the value of sugar in (efficiently produced) cane, around 9 p/kg. It is noted that in the UK, white sugar sells at 73p/kg, while in Brazil, amorphous white sugar sells for 25-30 p/kg.

Figure 3: Imported sugar



Of course the above prices are not strictly comparable, because the 96° Pol raw cane sugar would need to be shipped, imported duty free, trucked and dissolved in water, while the sugar juice in the beet roots must be extracted to be fermented. This in itself raises some interesting possibilities for a new beet/ethanol development based on new extraction technology. The extreme care which must be taken, when white sugar is to be the product, should not be necessary for the extraction of fermentable sugar for ethanol fuel. For this reason, it is likely that the sophisticated extraction processes of the conventional sugar beet factory (cossette slicing, followed by diffusion and clarification) are not necessary, and could be replaced by a much simpler and much cheaper maceration or milling process to release sugar juice from the beet root cells. To assess this concept, an independent laboratory and pilot

plant evaluation would be necessary, but if successful, it could lead to the creation of an alternative market for sugar beet. A recent paper (Schweitzer 2006) reviews the differences in the EU legal framework governing construction of sugar beet plants for food and those for ethanol fuel production.

Bearing in mind that the world average cost of producing cane sugar is probably about twice that of Brazil, the British farmer should be able to compete even with duty-free imported bulk raw cane sugar. However, the new EU sugar regime does not, presently distinguish between sugar as a food product and sugar as the raw material for fuel production, and if British agriculture is to play a major role in providing fuel crops, it may need to be protected from dumped world surpluses.

Cost of ethanol from UK beet and wheat

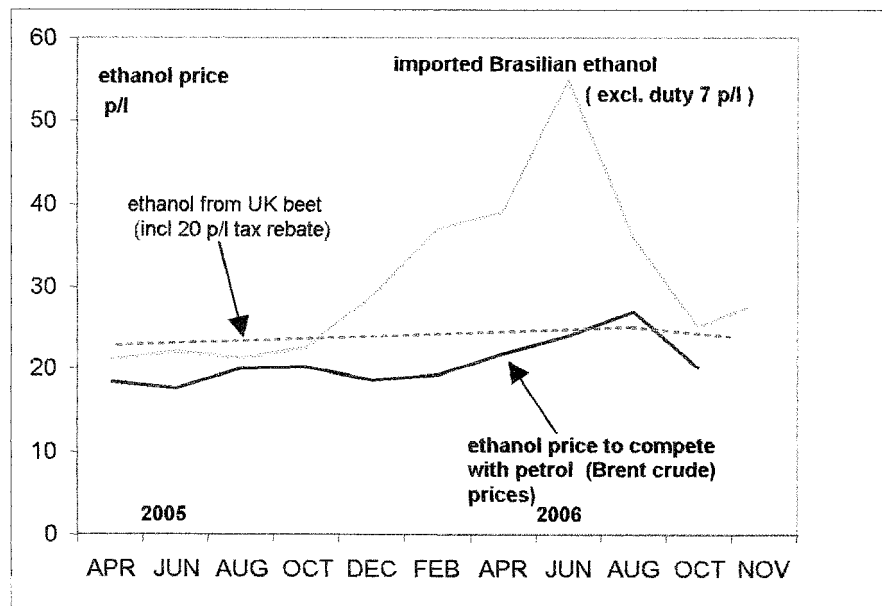
With a yield of 1 hl ethanol per t beets, every £/t beet adds 1 p/l ethanol to the feedstock cost: thus when the price of beet drops to £19/t (plus transport costs around £3/t), the feedstock cost would be 22p/l. For wheat, the yield is 3.7 hl ethanol/t wheat, and every £10/t wheat adds 2.7 p/l ethanol to the feedstock cost: wheat prices have recently risen sharply, and at the current *delivered* wheat price around £95/t (week 42), the feedstock cost would be about 26p/l (Farmers Weekly Interactive (2006b)). At these prices wheat is no longer the cheaper feedstock, and, furthermore, since it is a starch, it must be hydrolysed (saccharified) to sugars before it can be converted by yeast to ethanol. This adds an extra processing stage and extra cost which should be compared with the cost of the sugar extraction processes for beet, referred to above. The possibility of converting starches directly into ethanol is of great importance, and this whole area offers many challenges and opportunities for new microbiological processes and new technology.

Some idea of capital and operating costs can be gained from press reports (see for instance Eastern Daily Press 2002 and 2006) relating to the plant currently under construction at the Wisington sugar beet factory owned by the British Sugar Co. The design capacity was 55,000t ethanol/a (70 Ml/a) and the capital cost was put at £25M, subsequently reduced to £20M. Assuming normal levels for interest, depreciation and maintenance, the capital costs would lay around 7 p/l at full capacity.

With regard to operating costs, in 2002 BSC announced a 100,000t ethanol/a Wisington project with a capital cost put at £50M. The price of beets was then about £31/t, and oil \$30/bl, but the Company stated that the project would not be commercially viable without a tax rebate of 28 p/l. The current 55,000t/a project should come on stream early in 2007: with *delivered* sugar beets this campaign put at £26/t, a commercial price including profit is estimated to be around 42- 45p/l which, with a tax rebate of 20 p/l, sets the selling price around 22-25 p/l. This estimate can be compared with the French costing (Jeanroy 2000) published in 2000, when the price of "C ethanol" sugar beet was €22.7/t (then = £14.3/t) and crude oil was US\$30/bl: the total ethanol cost was put at €54.1/hl (then =34.3 p/l), curiously similar to the UK estimate above where the feedstock cost is some 12 p/l higher. French ethanol enjoys a tax rebate equivalent to about 30 p/l.

Figure 4 shows a projected UK price for imported Brazilian ethanol based on CBOT data (World Association of Beet and Cane Growers 2006), and when duty of 7p/l (€105/cu.m) is added, the estimated UK beet ethanol cost is seen to be competitive. But Figure 4 shows that it has only been able to compete with petrol for the brief period when crude oil went over \$70/bl around July/Aug 2006. However, other savings are available when ethanol and white sugar are co-produced in the factory.

Figure 4: Imported versus UK ethanol



Co-production of sugar and ethanol at the beet factory

When both refined sugar and ethanol are made together in the same factory, the technology of making that sugar is changed radically. This concerns what is known as “*after-product working*” in which the maximum amount of crystal sugar is extracted from the less pure syrups and molasses before the latter is returned to the farmer in “*molassed pulp*”. These processes, described as “*molasses de-sugarisation*” can make use of highly sophisticated techniques which are costly to install and operate, and, furthermore, involve substantial recycling and recrystallisation of the product stream, which in turn incur additional steam and energy costs.

With a product mix of 50% sugar-50% ethanol, the lower purity syrups can be passed directly to the fermenters, the after-product working and recycling is eliminated, and the total cost per ton of making (albeit less) sugar could be reduced by up to some 40%. In the Wisington project, before the butanol project was announced, the planned ethanol production was 55,000t/a, which would consume some 120,000t of sugar, (equivalent to some 700,000t of beets) or about 25% of Wisington’s sugar production capacity. There are no published UK data yet, but it may be assumed that the factory will cease to produce molasses. If all of the savings made in the sugar processing are applied to the ethanol costing, those savings could amount to 5 - 10 p/l

ethanol, and the potential commercial price of the ethanol would then be reduced to around 15 - 20 p/l, at which level it could compete at crude oil prices around \$60/bl. The profitability of ethanol manufacture from beets would be further improved by the use of cheap “surplus” non-quota beets, but any suggestion that ethanol, or butanol, would be made in the beet factory *only from* such “surplus” beets seems implausible. With crude over \$70/bl, a beet price of £19/t is too low.

The use of ethanol as a motor fuel.

There are three ways to use ethanol:

- hydrated, as it comes off the still at 97.5% ethanol
- anhydrous, at >99.5% ethanol, mixed with petrol
- converted to ETBE at the oil refinery.

The original Brazilian PROALCOOL scheme envisaged that hydrated ethanol would become the national motor transport fuel, and until the late 1980's, it looked as though this would be achieved, with sales of the special ethanol-engined cars exceeding 600,000 per year (DATAGRO 2003). But the difficulty of ensuring nationwide reliable supplies of both petrol and ethanol has led to a revision of the objective, and today sales of pure ethanol cars are down 90%. They are being replaced by conventional engines which use the national blend of up to 26% anhydrous ethanol in petrol, or by flexifuel engines which can use any blend up to 85% ethanol.

Anhydrous ethanol is a good replacement for lead as an octane booster, but its use does pose problems for the oil refiner and petrol manufacturer. It is hygroscopic (i.e. picks up water vapour from the atmosphere which would impair its blending with petrol) and it increases the vapour pressure of petrol, which means that when ethanol is added, other additives, like butane, must be “backed-off”. In France and Spain, bioethanol is converted to ethyl t-butyl ether (ETBE) by reaction with iso-butylene, one of the by-products of oil refining, and the ETBE is blended with petrol at the level of 15%, (about 6.5% ethanol). It is an excellent petrol additive (Agra-net 2006), but supplies of iso-butylene are limited, and to achieve the 2020 EU target of 8% by energy, anhydrous ethanol will have to be blended. There is a challenge here for the petroleum industry itself to initiate or support the development of new derivatives from agricultural crop products, and butanol is an example.

Butanol

In conclusion of this Section 5 on ethanol, British Sugar has recently announced a joint venture with BP and Dupont (*UK Biofuel*) to make butanol rather than ethanol at its Wissington Factory. Little has appeared in the press since then, and there is little information available on the Dupont manufacturing process, other than that it is a 2 stage bacterial fermentation of carbohydrate and presumably can use either wheat or sugar as feedstock. Butanol is an alcohol (C₄H₉OH) and has energy content (33MJ/kg) some 22%

higher than that of ethanol (C₂H₅OH), which means that it commands a higher fuel price than ethanol. Being chemically closer than ethanol to petrol, it does not have the volatility or hygroscopic problems of ethanol and would cause fewer problems to the petroleum industry. However, there is no production of “biobutanol” reported in either Brazil or USA.

Conclusions

The creation of a UK road transport biofuels industry would revolutionise British agriculture and its challenge opens up a spectrum of opportunities:

- Higher yielding/lower cost crop varieties, using GM technology for FUEL rather FOOD products.
- New extractive process industries which would provide competitive markets for UK agricultural crops.
- New crop-based fuels and fuel additives developed by the chemical and petroleum industries.

But there are many constraints and risks:

- Until the price of crude oil goes over \$150/bl, biofuels from UK crops cannot compete with petroleum products without governmental support, which has been very late in coming.
- Imported tropical crop products will pose a competitive threat to British farmers and UK tax incentives may have to be limited to biofuels produced from UK crops.
- The lack of arable land limits the UK’s capacity to produce its own road transport fuels to <10%
- In these early stages in the creation of a new industry, considerably more Governmental assistance and pressure is essential, especially with regard to the development of new technology.

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Biographical Notes

Dr Michael Bennett has a PhD in Chemistry from King's College, London, and has spent his entire professional life in the sugar industry. After 6 years in Trinidad, he joined Tate & Lyle where he became involved in engineering projects around the world. As Divisional MD of Tate & Lyle's Technical Products Group, he was personally involved in the biofuels development programmes of both Brazil and USA. He was a Director of Tate & Lyle Industries Ltd, and retired in 1990 as Tate & Lyle Technical Director. More recently he has worked with the authors of the DTI and EEDA reports on the UK potential for biofuels.

As chairman of international, US and British sugar technology societies, he has made keynote presentations at international meetings in Brazil, Colombia, Philippines, USA and the UK, and has won several awards. He is a Fellow of the Royal Society of Chemistry and a member of the NFU.

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CONFERENCE PAPER

CLIMATE CHANGE AND UK AGRICULTURE*

Sir John Houghton

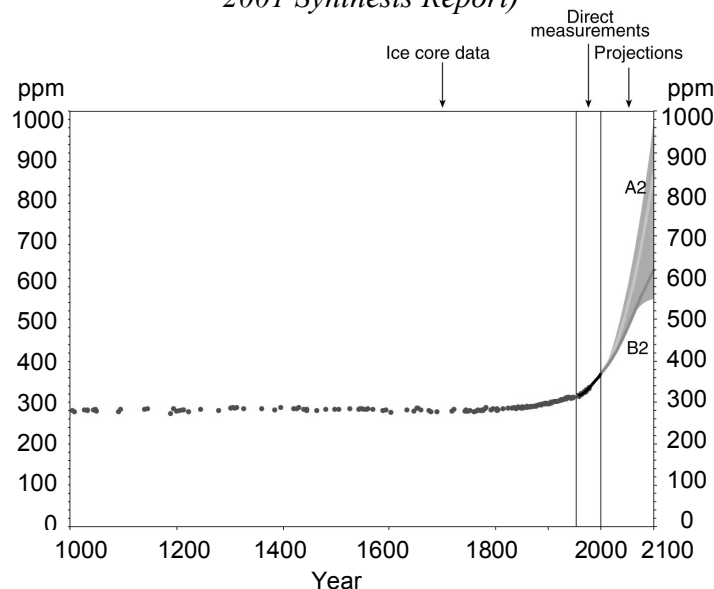
After a brief introduction to the science of climate change, this paper looks at the impacts on our society and the national and international governmental responses. Opportunities for agriculture, through production of bio-gas and bio-fuels, are discussed. The author concludes that to 'wait and see' is not an option, and that action is needed at all levels of society in response to evidence of global warming.

Climate change due to human activities is often stated to represent the biggest challenge facing the world in the 21st century. In this paper I will describe our latest understanding regarding the science and the impacts and then address some of the policy options especially as they affect UK agriculture.

I begin with a quick summary of the basic science. By absorbing infra-red or 'heat' radiation from the earth's surface, 'greenhouse gases' present in the atmosphere, such as water vapour and carbon dioxide, act as blankets over the earth's surface, keeping it warmer than it would otherwise be. The existence of this natural 'greenhouse effect' has been known for nearly two hundred years; it is essential to the provision of our current climate to which ecosystems and we humans have adapted.

Since the beginning of the industrial revolution around 1750, one of these

Figure 1: Past and future CO₂ atmospheric concentrations (from IPCC 2001 Synthesis Report)

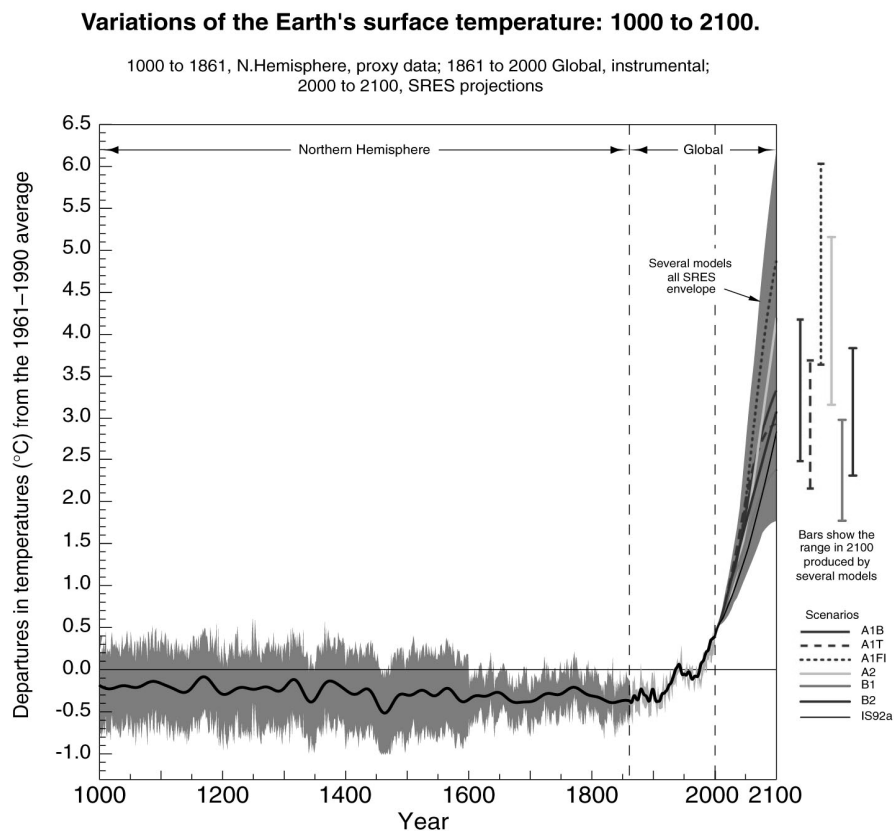


* This paper was given at the Oxford Farming Conference, January 2007, and is published by kind permission of the Conference Secretariat and the author.

greenhouse gases, carbon dioxide has increased by nearly 40% and is now at a higher concentration in the atmosphere than it has been for many thousands of years (Figure 1). Chemical analysis demonstrates that this increase is due largely to the burning of fossil fuels - coal, oil and gas. If no action is taken to curb these emissions, the carbon dioxide concentration will rise during the 21st century to two or three times its pre-industrial level.

The climate record over the last 1000 years (Figure 2) shows a lot of natural variability – including, for instance, the ‘medieval warm period’ and the ‘little ice age’. The rise in global average temperature (and its rate of rise) during the 20th century is well outside the range of known natural variability. The year 1998 is the warmest year in the instrumental record. A more striking statistic is that each of the first 8 months of 1998 was the warmest on record for that month. There is strong evidence that most of the warming over the last 50 years is due to the increase of greenhouse gases, especially carbon dioxide. Confirmation of this is also provided by observations of the warming of the oceans. The period of ‘global dimming’ from about 1950 to 1970 is most likely due to the increase in atmospheric particles (especially sulphates) from industrial sources. These particles reflect sunlight, hence tending to cool the surface and mask some of the warming effect of greenhouse gases.

Figure 2: Variations of the Earth's surface temperature. 1000 to 2100

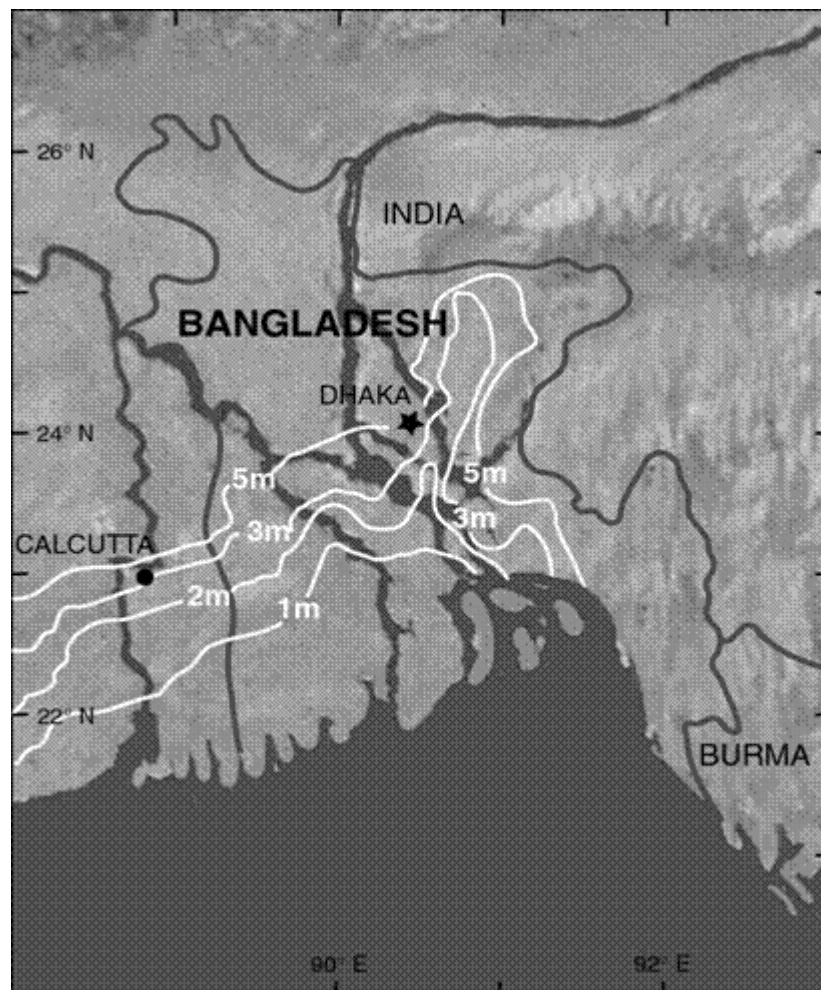


Notes: 1000 to 1862, N. Hemisphere, proxy data; 1862 to 2000 Global, instrumental; 2000 to 2100, SRES projections

Over the 21st century the global average temperature is projected to rise by between 2 and 6 °C (3.5 to 11 °F) from its preindustrial level; the range represents different assumptions about emissions of greenhouse gases and the sensitivity of the climate model used in making the estimate (Figure 2). For *global average* temperature, a rise of this amount is large. Its difference between the middle of an ice age and the warm periods in between is only about 5 or 6 °C (9 to 11 °F). So, associated with likely warming in the 21st century will be a rate of change of climate equivalent to say, half an ice age in less than 100 years – a larger rate of change than for at least 10,000 years. Adapting to this will be difficult for both humans and many ecosystems.

Talking in terms of changes of global average temperature, however, tells us rather little about the impacts of global warming on human communities. Some of the most obvious impacts will be due to the rise in sea level that occurs because ocean water expands as it is heated. The projected rise is of the order of half a metre a century and will continue for many centuries – to warm

Figure 3: Sea-level transgression scenarios for Bangladesh



the deep oceans as well as the surface waters takes a long time. This will cause large problems for human communities living in low lying regions. Sea defences in many parts of the UK, for instance in the eastern counties of England, will need to be improved at substantial cost. However, many areas in other parts of the world, for instance in Bangladesh (where about 10 million live within the one metre contour – Figure 3), southern China, islands in the Indian and Pacific oceans and similar places elsewhere in the world will be impossible to protect and many millions will be displaced.

There will also be impacts from extreme events. The extremely unusual high temperatures in central Europe during the summer of 2003 led to the deaths of over 20,000 people. Careful analysis leads to the projection that such summers are likely to be average by the middle of the 21st century and cool by the year 2100.

Water is becoming an increasingly important resource. A warmer world will lead to more evaporation of water from the surface, more water vapour in the atmosphere and more precipitation on average. Of greater importance is the fact that the increased condensation of water vapour in cloud formation leads to increased latent heat of condensation being released. Since this latent heat release is the largest source of energy driving the atmosphere's circulation, the hydrological cycle will become more intense. This means a tendency to more intense rainfall events and also less rainfall in some semi-arid areas.

On average, floods and droughts are the most damaging of the world's disasters. Between 1975 and 2002, due to flooding from rainfall over 200,000 lives were lost and 2.2 billion affected and due to drought over half a million lives were lost and 1.3 billion affected.¹ Their greater frequency and intensity is bad news for most human communities and especially for those regions such as south east Asia and sub-Saharan Africa² where such events already occur only too frequently. For the most extreme droughts that currently affect about 2% of the world's land area at any one time (20 years ago this applied to only 1% of the world's land area), recent estimates are that by 2050 over 10% of the world's land area will be so affected.³ Further, extreme droughts will tend to be longer, measured in years rather than months, again leading to many millions of displaced people.

Sea level rise, changes in water availability and extreme events will lead to increasing pressure from environmental refugees. A careful estimate⁴ has suggested that, due to climate change, there could be more than 150 million extra refugees by 2050.

In addition to the main impacts summarised above are changes about which there is less certainty, but if they occurred would be highly damaging and possibly irreversible. For instance, large changes are being observed in polar regions. With the rising temperatures over Greenland, it is estimated that melt down of the ice cap could begin during the next few decades. Complete melt down is likely to take many centuries but it would add 7 metres (23 feet) to the sea level.

A further concern is regarding the Thermo-Haline Circulation (THC) – a circulation in the deep oceans, partially sourced from water that has moved in the Gulf Stream from the tropics to the region between Greenland and

Scandinavia. Because of evaporation on the way, the water is not only cold but salty, hence of higher density than the surrounding water. It therefore tends to sink and provides the source for a slow circulation at low levels that connects all the oceans together. This sinking assists in maintaining the Gulf Stream itself. In a globally warmed world, increased precipitation together with fresh water from melting ice will decrease the water's salinity making it less likely to sink. The circulation will therefore weaken and possibly even cut off, leading to large regional changes of climate. Evidence from paleoclimate history shows that such cut-off has occurred at times in the past. It is such an event that is behind the highly speculative happenings in the film, *The day after tomorrow*.

I have spoken so far about adverse impacts. You will ask, 'are none of the impacts positive?' There are some positive impacts. For instance, in Siberia and other areas at high northern latitudes, winters will be less cold and growing seasons will be longer. Also, increased concentrations of carbon dioxide have a fertilising effect on some plants and crops which, providing there are adequate supplies of water and nutrients, will lead to increased crop yields in some places, probably most notably in northern mid latitudes. However, careful studies demonstrate that adverse impacts will far outweigh positive effects, the more so as temperatures rise more than 1 or 2 °C (2 to 3.5 °F) above preindustrial.

Many people ask how sure we are about the scientific story I have just presented. Let me explain that it is based very largely on the extremely thorough work of the Intergovernmental Panel on Climate Change (IPCC)⁵ and its last major report published in 2001. I had the privilege of being chairman or co-chairman of the Panel's scientific assessment from 1988 to 2002. Many hundred scientists drawn from many countries were involved as contributors and reviewers in these assessments. Our task was honestly and objectively to distinguish what is reasonably well known and understood from those areas with large uncertainty. The IPCC has produced three assessments - in 1990, 1995 and 2001 - covering science, impacts and analyses of policy options. The IPCC 2001 report is in four volumes each of about 1000 pages and containing many thousands of references to the scientific literature.⁶ Because the IPCC is an intergovernmental body, the reports' Summaries for Policymakers were agreed sentence by sentence by meetings of governmental delegates from about 100 countries - including all the world's major countries. No assessment on any other scientific topic has been so thoroughly researched and reviewed. In June 2005, just before the G8 Summit in Scotland, the Academies of Science of the world's 11 most important countries (the G8 plus, India, China and Brazil) issued a statement endorsing the conclusions of the IPCC and urging world governments to take urgent action to address climate change. The world's top scientists could not have spoken more strongly.

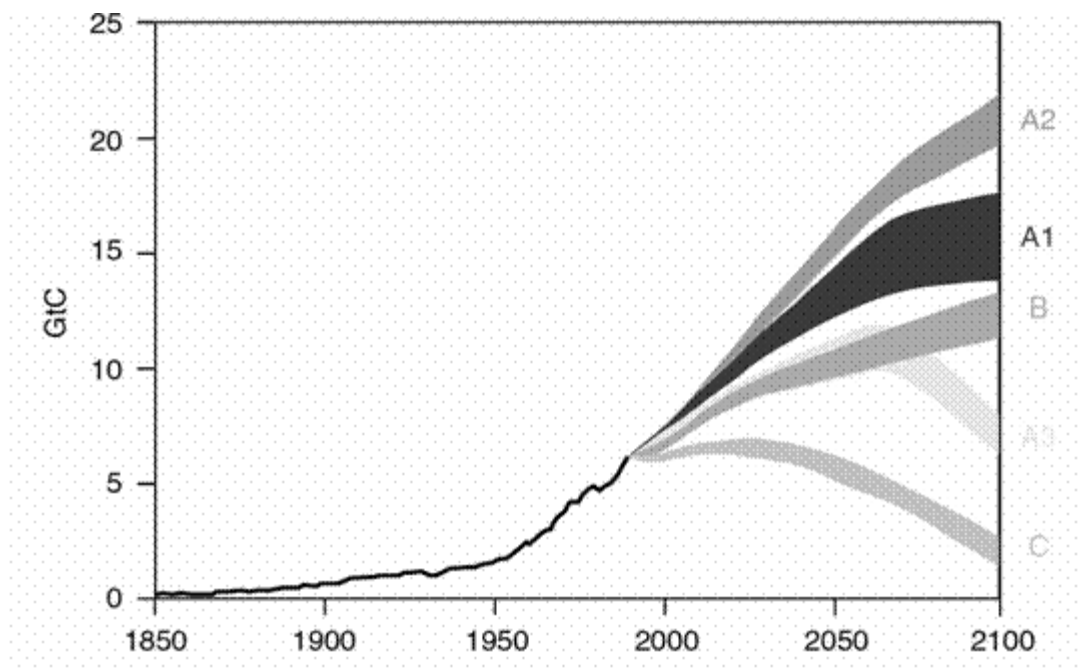
Unfortunately, there are strong vested interests that have spent tens of millions of dollars on spreading misinformation about the climate change issue. First they tried to deny the existence of any scientific evidence for rapid climate change due to human activities. More recently they have largely accepted the fact of anthropogenic climate change but argue that its impacts

will not be great, that we can ‘wait and see’ and in any case we can always ‘fix’ the problem if it turns out to be substantial. The scientific evidence cannot support such arguments.

Because of the work of the IPCC and its first report in 1990, the Earth Summit at Rio de Janeiro in 1992 could address the climate change issue and the action that needed to be taken. The Framework Convention on Climate Change (FCCC) - agreed by over 160 countries, signed by President George Bush Snr for the USA and subsequently ratified unanimously by the US Senate – agreed that Parties to the Convention should take “precautionary measures to anticipate, prevent or minimise the causes of climate change and mitigate its adverse effects. Where there are threats of irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures.”

More particularly the Objective of the FCCC in its Article 2 is “to stabilise greenhouse gas concentrations in the atmosphere at a level that does not cause dangerous interference with the climate system” and that is consistent with sustainable development. Such stabilisation would also eventually stop further climate change. However, because of the long time that carbon dioxide resides in the atmosphere, the lag in the response of the climate to changes in greenhouse gases (largely because of the time taken for the ocean to warm),

Figure 4: Global emissions of carbon dioxide from fossil fuel burning (in billions of tonnes of carbon) up to 1990 and as projected to 2100 under World Energy Council scenarios



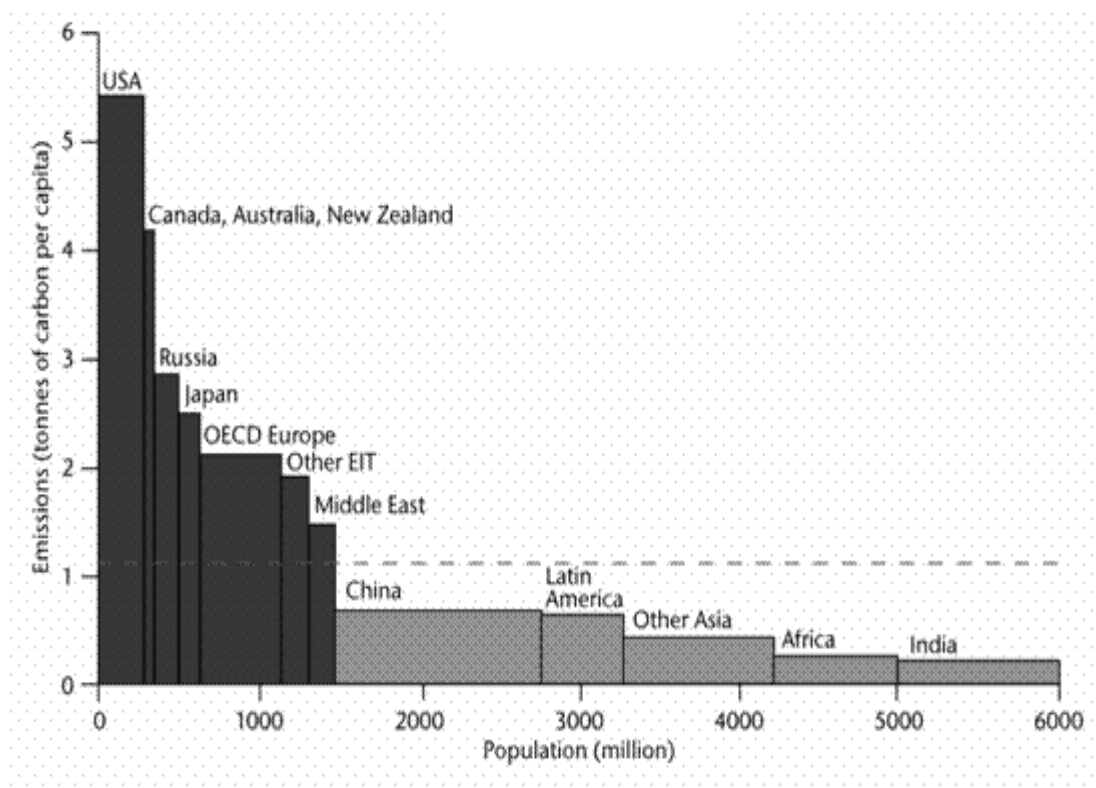
Notes: As and Bs represent various ‘business as usual’ assumptions; C represents ‘ecologically driven scenario’ that would lead to stabilization of carbon dioxide concentration at about 500 ppm.

and the time taken for appropriate human action to be agreed, the achievement of such stabilisation will take at least the best part of a century.

Global emissions of carbon dioxide to the atmosphere from fossil fuel burning are currently approaching 7 billion tonnes of carbon per annum and rising rapidly (figure 4). Unless strong measures are taken they will reach two or three times their present levels during the 21st century and stabilisation of greenhouse gas concentrations or of climate will be nowhere in sight. To stabilise carbon dioxide concentrations, emissions during the 21st century must reduce to a fraction of their present levels before the century's end (cf lowest curve in figure 4).

The reductions in emissions must be made globally; all nations must take part. However, there are very large differences between greenhouse gas emissions in different countries. Expressed in tonnes of carbon per capita per annum, they vary from about 5.5 for the USA, 2.5 for Europe, 0.7 for China and 0.2 for India (Figure 5). Ways need to be found to achieve reductions that are both realistic and equitable – for instance by following a suggestion of the Global Commons Institute⁷ called Contraction and Convergence that proposes convergence within a few decades to equal per capita allowances of carbon dioxide together with trading within those allowances.

Figure 5: Carbon dioxide emissions in 2000, per capita versus population
(after Grubb, M. (2003) *The Economics of the Kyoto Protocol World Economics* 4, 3, p145)



We, in the developed countries have already benefited over many generations from abundant fossil fuel energy. The demands on our stewardship take on a special poignancy as we realize that the adverse impacts of climate change will fall disproportionately on poorer nations and will tend to exacerbate the increasingly large divide between rich and poor.

The Kyoto Protocol set up by the FCCC represents a beginning for the process of reduction, averaging about 5% below 1990 levels by 2012 by those developed countries who have ratified the protocol. It is an important start demonstrating the achievement of a useful measure of international agreement on such a complex issue. It also introduces for the first time international trading of greenhouse gas emissions so that reductions can be achieved in the most cost effective ways.

Serious discussion is now beginning about international agreements for emissions reductions post Kyoto. These must include all major emitters in both developed and developing countries. On what eventual level of stabilisation, of carbon dioxide for instance, should these negotiations focus? To stop damaging climate change the level needs to be as low as possible. In the light of the FCCC Objective it must also allow for sustainable development. Let me give two examples of stabilisation proposals. In 1996 the European Commission proposed a limit for the rise in global average temperature from its preindustrial value of 2 °C – that implies a stabilisation level for carbon dioxide of about 430 ppm (allowing for the effect of other greenhouse gases at their 1990 levels). The second example comes from Lord John Browne, Chief Executive Officer of British Petroleum, one of the world's largest oil companies, who in a recent speech proposed 'stabilization in the range 500-550 ppm' that 'with care could be achieved without disrupting economic growth'.

Consider carbon dioxide stabilisation at 500 ppm. If the effect of other greenhouse gases at their 1990 levels is added, it is about equivalent to doubled carbon dioxide at its preindustrial level and a rise in global averaged temperature of about 2.5 °C. Although climate change would eventually largely be halted – although not for well over a hundred years - the climate change impacts at such a level would be large. A steady rise in sea level will continue for many centuries, heat waves such as in Europe in 2003 would be commonplace, devastating floods and droughts would be much more common in many places and Greenland would most likely start to melt down. The aim should be therefore to stabilise at a lower level. But is that possible?

The UK government has taken a lead on this issue and has agreed a target for the reduction of greenhouse gas emissions of 60% by 2050 - predicated on a stabilisation target of doubled carbon dioxide concentrations together with a recognition that developed countries will need to make greater reductions to allow some headroom for developing countries. Economists in the UK government Treasury Department have estimated the cost to the UK economy of achieving this target. On the assumption of an average growth in the UK economy of 2.25 % p.a., they estimated a cost of no more than the equivalent of 6 months' growth over the 50 year period. Similar costs for achieving stabilisation have been estimated by the IPCC.

Let me now address the actions that need to be taken if the reductions

required are to be achieved. Three sorts of actions are required. First, there is energy efficiency. Very approximately one third of energy is employed in buildings (domestic and commercial), one third in transport and one third by industry. Large savings can be made in all three sectors, many with significant savings in cost. But to achieve these savings in practice will require appropriate encouragement and incentives from central and local government and a great deal of determination from all of us.

Secondly, a wide variety of non-fossil fuel sources of energy are available for development and exploitation, for instance, biomass (including waste), solar power (both photovoltaic and thermal), hydro, wind, wave, tidal, geothermal energy and nuclear. Thirdly, there are possibilities for sequestering carbon that would otherwise enter the atmosphere either through the planting of forests or by pumping underground (for instance in spent oil and gas wells). The opportunities for industry for innovation, development and investment in all these areas is large.

Let me now say more about energy from biomass sources and how UK farmers might contribute. Biomass is a renewable resource. Carbon dioxide, of course is emitted when biomass is burnt or digested but on growing the next crop the carbon is 'fixed' back in the crop. When fossil fuels are burnt no such replacement occurs.

The possibilities for biomass use are (1) to grow crops for feed to power stations or to produce biogas or hot water; (2) to grow crops for conversion into biofuels and (3) to use 'biological' waste, agricultural or domestic, to produce electricity, hot water, biogas or biofuels. Because biomass is bulky, transport costs can be large. Biomass is best used therefore to provide local energy or relatively small additional feed to large power stations (for instance, it is planned that 7% of the feed to the Aberthaw power station in South Wales should be from biomass). There are substantial advantages in *local* energy schemes. For instance, they can easily include Combined Heat and Power (CHP) so achieving nearly double the efficiency of schemes providing power alone. They also bring employment to rural areas and a feeling of ownership to local communities. Further, they are also more secure not being liable to political interference.

In Upper Austria, with 1.5 million population, in 2003, 14% of their energy came from local biomass. This is planned to increase to 30% by 2010 and to continue to grow substantially thereafter. By contrast the UK raises only about 1% of its energy this way ⁸ one of the lowest levels in Europe, although the Royal Commission on Environmental Pollution believes it could be ~ 10 % by 2050.⁹ In the USA, the Energy Future Coalition are putting forward '25 by 25' – a target that 25% of total US energy needs should be provided from biomass sources by 2025.

What are the characteristics of an ideal energy crop? High outputs are clearly desirable assisted for instance by a long growing season and high rates of photosynthesis. Low inputs are essential; in energy terms inputs clearly have to be less than a small fraction of the energy output expected. This means high nutrient efficiency so that there is little need for fertilizer, high water use efficiency and minimum management – a perennial crop with few pests and diseases. These characteristics tend to rule out annual grasses such as cereals,

maize and sorghum but rule in short-rotation coppice willow from a list of woody species and *Miscanthus* (“elephant grass”) from a list of perennial grasses (figure 6).

Figure 6: Examples of mature miscanthus and willow stands



Note: On the left is an example mature *Miscanthus* growing in Germany which has grown 4m tall in 5 months. On the right is an example of a willow plantation at IGER, Aberystwyth with 2 years of growth since it was cut back (from IGER Aberystwyth).

Let me give an example of what might be provided in the UK. Supposing an area of 1Mha (e.g. 100 km x100 km) were considered to be available¹⁰ this is 9% of UK's total agricultural land or 15% of land of grades 3 and 4. Assuming an average yield of 18 tonne/ha/yr and energy conversion of 15 gigajoules per tonne, from 1 Mha the energy output would amount to about 3% of UK's total energy needs. The development of greater yields and conversion efficiencies together with the use of more land could bring this 3% up to around 10% - a substantial contribution to the reduction of carbon emissions and the mitigation of climate change.

Technologies are available for using *Miscanthus* not only to produce energy directly but also as a source crop for biogas and biofuels. These technologies require urgently to be developed so that they can be employed on the large commercial scales that are necessary.¹¹ Dr John Valentine at IGER looks forward to this future development:

The modern dairy cow is highly efficient in processing grasses using its rumen – essentially a fermentation vessel containing diverse micro-organisms. The energy locked up in the cell walls is released by breaking down cellulose and hemicellulose into simple sugars. This energy together with that from the already available soluble sugars fraction can then be used by the cow to fuel milk and meat production.

What my colleagues at IGER are seeking to do is to develop a system to release bioenergy by replacing the rumen by a fermentation vat to produce biofuels such as bioethanol or biobutanol. Together with companies in the USA and UK, the search is on for micro-organisms and enzymes that can efficiently break down the ligno-cellulose in the grass to release the sugars. Ideally, initial sugar fermentation will take place on-farm, so that sugar liquor could be transported for further processing rather than bulky grass.¹²

Let me turn to the use of waste for energy. It has been estimated that the potential energy value in agricultural and forestry wastes and residues could, if realised, meet at least 10 % of the World's total requirement for energy¹³ a very significant contribution. For the UK, domestic, industrial, agricultural and forestry wastes amount to about 20 million tonnes per annum and could provide about 4% of the UK's total energy needs.¹⁴ Disposal of waste and generation of energy can with advantage be put together. There are many examples. In south London, for instance is the BedZED development – the largest carbon neutral housing project in the UK. It is a complex of 82 homes, developed to demonstrate the possibility of 'Zero-Emissions Developments'. It obtains its heat and power from using forestry residue. The Shell Foundation, a charity of which I am a Trustee, is supporting the development of many such biomass pilot schemes in poorer countries that range from using sewage from latrines in India, coconut shells in the Philippines and rice straw in China. All these could be multiplied many times over and they point to an important component of the way forward for developing countries where it is vital that local energy provision to rural areas is developed to improve their local quality of life and to enable small and medium sized industries to develop.

Let me now address those who argue that we can 'wait and see' before action is necessary. That is not a responsible position. The need for action is urgent for three reasons. The first reason is *scientific*. Because the oceans take time to warm, there is a lag in the response of climate to increasing greenhouse gases. Because of greenhouse gas emissions to date, a commitment to substantial change already exists, much of which will not be realised for 30 to 50 years. Further emissions just add to that commitment. The second reason is *economic*. Energy infrastructure, for instance in power stations also lasts typically for 30 to 50 years. It is much more cost effective to begin now to phase in the required infrastructure changes rather than having to make them much more rapidly later. The third reason is *political*. Countries like China and India are industrialising very rapidly. I heard a senior energy adviser to the Chinese government speak recently. He said that China by itself would not be taking the lead in reducing greenhouse gas emissions. When the big emitters in

the developed nations take action, they will take action. China is building new electricity generating capacity of about 1 GW power station per week. If we want to provide an example of effective leadership we need to start now.

People often say to me that I am wasting my time talking about Global Warming. 'The world' they say 'will never agree to take the necessary action'. I reply that I am optimistic for three reasons. First, I have experienced the commitment of the world scientific community (including scientists from many different nations, backgrounds and cultures) in painstakingly and honestly working together to understand the problems and assessing what needs to be done. Secondly, I believe the necessary technology is available for achieving satisfactory solutions. My third reason is that I believe we have a God-given task of being good stewards of creation. For our fulfilment as humans we need not just economic goals but moral and spiritual ones. Near the top of the list of such goals could be long-term care for our planet and its resources. Reaching out for such a goal could lead to nations and peoples working together more effectively and closely than is possible with many of the other goals on offer.

Both the challenge and the opportunity for all of us are unmistakeable. And we all can contribute. To quote from Edmund Burke, a British parliamentarian of 200 years ago, 'No one made a greater mistake than he who did nothing because he could do so little.'

Notes.

1. Jonkman, S.N. 2005 *Natural Hazards* **34**, 151-175; the losses due to flooding only include those from rainfall and not those from storm surges from the sea for instance in tropical cyclones.
2. Defined according to the Palmer drought index that distinguishes between moderate, severe and extreme drought.
3. E J Burke, S J Brown and N Christidis, 2006, *Jnl Hydrometeorology*, **7**, pp 1113-1125
4. Myers, N., Kent, J. 1995. *Environmental Exodus: an emergent crisis in the global arena*. Washington DC: Climate Institute.
5. The IPCC was formed in 1988 jointly by two UN bodies, the World Meteorological Organisation and the United Nations Environment Programme.
6. *Climate Change 2001* in four volumes, published for the IPCC by Cambridge University Press, 2001. Also available on the IPCC web site www.ipcc.ch. My book, John Houghton, *Global Warming: the complete briefing*, 3rd edition, Cambridge University Press, 2004 is strongly based on the IPCC reports.
7. www.gci.org.uk

8. from Biomass Task Force Report – a report to UK government, October 2005
9. RCEP report *Biomass as a Renewable Energy Resource* 2004
10. a figure suggested by Biomass Task Force Report – a report to UK government, October 2005
11. information about current and emerging technologies can be found in, Global Watch Mission Report *Second Generation Biofuels*, DTI, March 2006 and A Research Roadmap resulting from the Biomass to Biofuels Workshop. Rockville, Maryland. June 2006.
12. from *Farm Business* 20 October 2006
13. from *World Energy Outlook 2006*, IEA, Table 14.6
14. from Biomass Task Force Report – a report to UK government, October 2005

Biographical Note.

Sir John's scientific career includes posts as Professor of Atmospheric Physics, Oxford University and Director General (later Chief Exec), UK Met office, where he took a particular interest in research into human induced climate change. He chaired Scientific Assessment on the newly formed intergovernmental panel on climate change (1998-2002).

After retiring from the met office, Sir John became chairman, Royal Commission on Environmental pollution (1992-8), Chairman, John Ray initiative, a charity formed to connect science, environment and Christianity in promoting environmental sustainability and a Trustee, Shell foundation.

He continues to lecture on climate change and its challenge to human communities. His many awards include the Japan Prize (2006) International Met organisational prize (1998) gold medals from the Royal Astronomical Society and the Royal Met society.

CONFERENCE PAPER

IF YOU NEVER TAKE A RISK YOU WILL NEVER REAP A REWARD¹*Doug Wanstall*

This paper outlines how a small family farm was developed into what it is today – a 5,000 acre (2000 ha) farm with a wholesale business, shops, a manufacturing unit and a restaurant. It discusses the establishment of the 'team' and its influence on productivity, and describes how the author challenged many conventions in the process of building his enterprises and the importance of developing a philosophy of tackling things 'head on'.

Bank Farm was bought by my great grandfather in 1918. I am the fourth generation.

For as long as I can remember I have had a desire to make money. At the tender age of ten or so I used to grow potatoes and onions and sell them to the customers of my families pick your own corn on the cob enterprise. This diversified into selling juice to them as they returned from picking, and a further service was added by offering to carry the customers' corn from the field. Incidentally this had two affects, firstly I made a modest margin but secondly because the customers did not have to carry the corn back, they actually bought more of it!! My business career took a break when I left the farm to go to boarding school. At school I continued to liquidise some assets to keep the tuck flowing. I used to sell the stamps my mother gave me, this didn't go down terribly well and it gave me my first experience in conflict management!

Following school I worked on a local mixed farm before going to Shuttleworth agricultural college.

My business career however did continue whilst at Shuttleworth, I set up a travelling Pimms Bar that followed the cricket team and supporters from match to match. Most of the profits were drunk but that really didn't seem to matter.

It was about three years after leaving college that I really settled down and began to sort out the home farm. At that point we were a medium sized, family mixed farm with arable, sheep and cattle. My Father and Uncle had steadily built the farm up, crucially buying parcels of land to increase the net worth of the holding, the essential foundation of any expansion. I quickly got rid of the beef fattening enterprise with BSE looming I couldn't see the point. The farm was still highly profitable, with wheat at over £100 per tonne and area aid having been introduced at a time when the pound was very weak anybody could have made money. The farm was to have to support three families and I quickly realised the good times were unlikely to continue as the MacSharry proposals began to take effect. So I started to look for opportunities.

The plan was to ensure that the business we built would not only be able to support the three families but to a good standard of living. I was prepared to look at anything, I had a few short term opportunities which made quick

1. This paper was presented at the UK National Farm Management Conference held at Basingstoke, 15 and 16 November 2006.

money but soon realised that if I was to make serious money I had to look at more long term plans.

My wife was interested in property and made some very astute purchases. We concentrated on run down seaside towns and our first two houses were old guest houses that we converted, one in Eastbourne we filled with 13 students and one in Margate that we filled with immigrants. The income stream was good, the immigrants rent was paid directly by the local council. The students were a bit more erratic but as soon as any of them went into arrears I went down and paid them a little visit.

After about two years we sold the houses as we had made a healthy profit and I rather naively thought that the growth wouldn't continue, but we used the money to buy our new family home with little mortgage this had the added affect of providing the security to enable the start of the business growth.

One of my short term plans or scams rather, that I am not particularly proud of was when I was given 40 knackered old donkeys at the end of the summer season, housed them and then put the word out that they were going to be exported to France, possibly for human consumption, it was amazing how much people would pay to save a donkey!!

I was very interested in the food industry and further research led us to see that the most rapidly growing part of the food industry was food service, areas such as hotels and restaurants. Convenience buying was also growing rapidly and still today seems to have no limits. The total annual consumer spend on food and drink is in the region of £127 billion, with the total gross value added figure for primary producers being £6.5 billion it was clear to me that we should be moving higher up the 'food chain' and capturing a little more of the margin ourselves, especially as I could see that in the supply chain there were some links that seemed to be superfluous to farmers needs.

I had also realised that there were the beginnings of a revolution towards traceability, buying direct from the producer and localness. I wanted a business that encompassed all of these. But where to start?

What I needed to start with was an enterprise that made money in its own right, had a future without subsidies and was easy to add value to. Free Range egg production ticked all the right boxes. We started production in 1997 with the well known Bowler free range franchise system, mainly because I knew nothing about the industry. It got us off to a good start but I soon became restless. I began by buying a small table top grader for £90 and selling eggs to local pubs, restaurants etc. That was easy; I bought off the shelf boxes and kept the costs to a minimum. The next big step was when a local business lady decided to retire and offered me her egg round; I jumped at the chance and soon had a van running two days a week selling eggs only. Our own sales developed and within six months had the van full and running five days per week.

Two fairly major events then occurred. I was offered a large egg round in London which had some of the highest profile customers in the market place; it was hard to turn down, because it was going to give me the infrastructure to move into a different league. We bought the round for too much money that is clear now, but it did give us the access to customers which we could sell anything to. At the same point we relieved ourselves of the obligation to supply our contracted packer and were then free to produce and supply our customers.

The most unfortunate thing of that episode of expansion was the fact that it

coincided with 9/11. London went quiet and we had to do something to prevent this from being an expensive mistake. The obvious move was to begin marketing other products to our new and discerning customer base. Buying business is something I will never repeat, it was expensive and unnecessary. Our current and future growth will be due to us being not only better than our competitors but offering products and services that are unique to us, effectively removing other suppliers as competition. The more we can offer our customers the more potential barriers to markets we will remove.

The first and most natural new products were liquid egg products, mayonnaise, ready boiled and peeled eggs, but quickly moved onto meat and game, fresh produce, honey, jams etc. We sold anything stinging nettles from around the farm for £7000 per tonne, sloes, and elderflowers if someone wanted something we did our best to provide it. My wife, Stephanie had a sales background and having left her job she joined the business in order to not only increase the volume sold to our existing customers but to gain more custom and to continually increase our product lines and customer service.

One product that we were struggling to get near to the big wholesalers on price were frozen chips until, that is I went on one of my fact finding expeditions around Tesco's. I could not buy frozen chips for less than 42p per kilo from any of the main suppliers and thus couldn't make enough of a margin and compete. I found value frozen chips in Tesco for only 23p/kg so all we do is buy them, rebag them and now make a decent margin. We now patrol the supermarkets and take advantage of any cheap deals, bogoffs etc. We cannot buy butter any cheaper than from Tesco and we buy it by the pallet load for our factory. Not only is it cheaper but I get a hell of a lot of club card points as well!!

Another major event that led to a significant change in our business was the introduction of the London congestion charge. Being a farmer I automatically began looking for ways to prevent paying for it. The answer came to me whilst reading an article in the Farmers Weekly on a beach in Antigua – bio-diesel. I knew that if one used clean fuels you could become exempt from the charge and the piece in the FW made production sound quite easy.

Bio-diesel can be made from any vegetable oil after what is quite a simple process and we knew our customers used a lot in their kitchens. I researched the production process and we built our system mostly from items that were lying around the farm. The biofuel industry is quite unique in that you can enter onto a search engine and find hundreds of enthusiasts just desperate to offer the benefit of their knowledge and experience.

The attraction to the customers was simple, we collected their oil free of charge as long as they bought the fresh oil from us and they also knew that their waste was being used for something that was environmentally friendly. In addition we were delivering their produce using clean fuel.

We built the business to a level where we were selling five tonnes of oil per week and producing the same amount of fuel. The fuel took no marketing at all and the customers were coming thick and fast, we could not keep up. Our largest customers were organic wholesalers as well as used lorry dealers. They used bio-diesel in trucks that had failed their emissions tests, with our fuel they would sail through! Recently however the Environment Agency has stopped us producing until we get a new license. We are still selling oil and

have subbed out our oil collection. It seems that our legislators cannot keep their hands off anything and continue to stifle enterprise. The real irony is that the EA have now come back and told us that we are free to continue without the license, after of course we have made the man redundant and moth-balled the site.

The future of the whole biofuel industry whether it be ethanol, bio-diesel or biomass for burning is huge. We are looking at developing a new mobile production site for bio-diesel and a crusher enabling us to convert either used or virgin oil. We will be working with dedicated oil collectors, neighbouring farmers and green developers who are showing a keen interest.

Whilst the expansion of the wholesaling business was going on we took on about 3500 acres of arable land on contract or management agreements and expanded our own free range production by another 7500 birds by converting a disused cattle building, we also set up a friend in free range production in order to fulfil our rapidly expanding egg business. We had also entered a lot of land into the countryside stewardship scheme and carried out many works to create new wildlife habitats on the farm. Within two years we were nominated for the Kent Business Environment Awards and won the Wildlife conservation category. Bank Farm had also become a LEAF (Linking Environment and Farming) demonstration farm, this served two purposes. Firstly it satisfied my need to display that farming has a positive side and that as an industry we provide much more than just food but secondly and quite importantly it helped to raise our profile. We cannot criticise the general public for not understanding our methods as their lack of understanding is only due to our failure to communicate the right messages. Organic farming has little or no bad press because they have a superb spokesman in the guise of Patrick Holden. Positive communication is exactly what our industry needs and LEAF helps me do that. As an industry the press is interested in us if we have a good story and picking up the phone and talking to them is a simple thing to do. I will give you a couple of examples. About three years ago there was a piece in the Daily Mail about a giant egg. I read it and kept the article. Within a few weeks we had an egg laid which was simply massive. Too good an opportunity to miss. I rather embarrassingly phoned the local paper and said "you probably won't be interested but I've got this giant egg". Within half an hour the reporter was there. That evening the story went live on the local news, the following day I had a call from a national paper and within two days had a call from Channel 4's Big Breakfast program asking me to go on with the egg. From that point I nurtured a relationship with the local and regional press, which within time and following a particular incident became very useful indeed.

We had an accident when our sprayer tipped over on the road, filled with chemical, bright orange Stomp no less which leaked down the road and into a nearby waterway. We immediately contacted the fire brigade and environment agency. It was at the same time the firemen were on strike and they made a real meal of it stating that had they not been there this would have turned into a massive environmental disaster. That at least was what they told the press. Fortunately the reporter phoned me to get a balanced view and the story was portrayed in an accurate manner, something that would not have happened if I had not been in constant contact with them.

As a direct result of our raised profile I was privileged to have been invited

to Buckingham Palace to have supper with The Duke of Edinburgh, Princess Ann other royals and representatives from industry. This event will stick in my mind forever if not for the sheer occasion then for what happened to me en route.

I was determined not to be late, so I left the farm early and parked in St James square and had a walk around London. I was wearing my dinner suit and was immaculately dressed. At about 7pm I thought I had better get back to the car, as I slid onto the seat I heard a massive tear and my trousers split from the belt loops to my crutch. I sat in the car and went absolutely cold, what should I do? Do I go and hope that no one notices? That wasn't an option as I could feel my britches flapping in the wind. I had just passed a few gentlemen's outfitters so I sprinted back to where I found them just in the process of closing. I stopped at the first one I saw and wedged my foot in the door and begged them to help. I was sworn to secrecy about where I was going so I said to the shop manager that he had to help me as I was going somewhere very important. He replied by saying that so did he – home!! So I thought there is only one thing for it so I told him that I was going to have supper at the palace with Prince Philip, he looked me up and down and said 'Of course you are sir' however he obviously took pity on me as I was so desperate that I would make up such a lie, that he helped. Dressed with a new pair of £150 trousers I left for the palace.

I was still on time and in fact was the first guest to arrive and went straight into a drawing room with only two other people - Prince Philip and Princess Anne. There was nothing for it so I told them the whole story: it was an excellent ice breaker!!

The most worrying part of the evening came in the guise of one of the other guests, chief economic editor of the Financial Times a Mr Martin Wolff. The idea of the evening was to discuss the economics of grants and subsidies. Although I do agree with the eventual end of subsidies in all guises, his attitude was to hell with UK agriculture, if food can be sourced cheaper abroad then buy it. He had no idea of the more integrated nature of agriculture in the community not to mention that in most years now consumption of basic food types exceeds production, and felt that if farming folded here than nobody would notice. He had no concept of the number of interested parties that influence our work place. For instance if I manufactured widgets, I would get a unit in Ashford somewhere and start manufacturing, without the worries of footpath walkers stomping across the factory floor or skylarks nesting in the gutters or indeed rabbits eating our profits. The most worrying thing was that this man has the ear of the politicians and policy makers. I use this as one of many reasons that farmers should not depend on these subsidies and grants that we are lucky to receive now, but use them to help build stronger businesses for the future. Depend on them and disaster looms!!

Four seasons ago we took a shoot on that was being run on one of our contract farms. The first thing we did was to shut the shoot for a season firstly because it had become quite rundown but also because we had taken on a keeper with TUPE protection who was not right for us it was the only way to get rid of him. There were two reasons for taking the shoot on, one because we felt that it would be a useful enterprise for the winter months but more importantly was to get control of the vermin, notably deer and rabbits. In the

first year on that farm we lost in the region of £30,000 in lost crop. We now cull huge numbers of both and sell them into London, effectively turning a threat into an opportunity. We now sell over 35 days per year to a selection of clients.

I had spent a lot of time building the wholesaling business and had somewhat neglected our arable enterprise and needed to re-focus on it.

We had two main elements of our business, on the one side we had an enterprise that was getting as close to the consumer and adding as much value as possible, the arable enterprise is all about efficient production of commodity products and lets face it quite difficult to set prices but not impossible!! Although one can rarely phone a grain merchant and demand a certain price for wheat, there are many things a business can do in order to secure margins.

My ethos with arable margins is simple, if I can see a margin I will sell a proportion of my harvests crop, I often have three harvests being marketed at the same time, I rarely hit the highest price but I do always achieve a good average and I do remove an element of risk. It may sound bizarre to some of you that I talk about reducing risk when we have taken so many. The answer is simple. Without the sheer scale of the business to start with we would not produce enough income to secure our objectives. Once the scale is in place I will do anything to secure the margins and that means removing risk. Our arable farm scale has enabled us to invest heavily in new technology to again help margins by the precise use of fertilizers and satellite navigation of the main tractors; it all helps to make us more productive.

We have also improved the reliability of arable margins with extensive use of the countryside stewardship scheme. In any one year we will have over 200 acres of summer fallow. This not only satisfies my own environmental desires but secures a net crop margin that leaves most combinable crops in the shade. Our strategy now is to look for new opportunities growing higher value crops in partnership with vegetable producers, commodity crops for local markets and to grow for our own wholesale and retail business. The core objective of the arable enterprise remains however reducing costs and increasing output. We have reduced our arable staff from 5 to 2 and removed a tier of management

We had a sheep enterprise until 2005 but with the introduction of the SFP it no longer stacked up and so they went, my father was a little sad to see them go especially as we had had cloven hoofed animals on the farm since it was bought three generations before, but reality is reality and he seems to have got over it now.

We had become very successful at selling produce to shops, hotels, restaurants etc and had launched Bank Farm retail, a brochure that puts together many food producers and allows shops to buy the local produce they want from one source, it also gives other producers access to our customer base. It was promoted with the catch line 'One supplier, one invoice hundreds of local products' as our research proved that it was what retailers were after. We also thought that it was all very well telling people that these products would sell, but proving it would be easier if we had our own shops. Thus the Farm Shop was launched. It is our plan to set up a chain of good quality farm shops boosted by The Farm Shop Direct a web based retail portal that is

nearing completion.

We are currently undertaking a massive review of BFP as we have grown well and attracted larger and larger customers but still serve small corner shops that actually lose us money so we are going to reduce the number of customers we have and re-focus on not only selling more but improving the service to our larger ones.

The final link in the integrated business that is Bank Farm was to be 'Just Good Foods' From the beginning of the business plan one aim was to have a facility that adds value to basic food products. It was accelerated when I met a chap from the village who had worked at Brake Brothers for a long time and who was having food manufactured for him in a different part of the country. So we got our heads together and with the aid of a DEFRA grant built a new production facility. The timing was excellent as locally the original Brake Brothers factory closed after the company was sold and we managed to cherry pick the best of the staff, including many of the management.

The factory now manufactures a range of ready meals that includes anything from Mash potato and chips to Lasagne, curries and *en croute* products. We manufacture the meals for food service customers as well as retailers and of course the Bank Farm wholesale business. Many of you would have eaten them without realising. The meals, where possible are made from ingredients sourced from local farms, providing more and more outlets for farmers and producers to gain a fairer price, to get closer and build a working relationship with the end user

Just Good Foods has been the riskiest enterprise I have ever set up however it is set to exceed expectations. It is a business that demands constant innovation and it is innovation that will sustain our long term competitiveness in all of our businesses. The business also needs other farmers to help us by managing certain produce categories. For instance we have one local farmer who has invested in meat cutting and hanging facilities to provide his home grown beef, pork and lamb to our factory and shops, we buy meat for the same value as from any other meat wholesaler, the point being that he has removed links from the supply chain and thus retains the profit for himself.

I have now removed myself from the day to day management of the ready meal business and retain a shareholding as it quickly proved that I could not give it the constant attention it needed or indeed had the experience.

Bank Farm has been part of a 10 farm study to attempt to identify the secret of sustainability. Everyone has their own definition of sustainability, so here's mine. The first key is financial sustainability, get that right first. Then it is to provide enough, safe and wholesome food in a way that encompasses and enhances the environment around us. I have many arguments with people, notably Jonathon Porritt who recently stated that organic farming is the gold standard of sustainability. I am a fan of organic farming as a means of adding value and market differentiation we have in fact just entered a block of land into conversion as I can see a marketing opportunity for us in the future. Organic farming is however not sustainable. If the whole of the UK was to turn organic we would need to find an area the size of Wales to produce as much food as we do now. I argue that conventional farming is the best way of preserving the areas of the world of great environmental importance as all the time we strive to grow as much food on as smaller area as possible these areas

will not be required to grow food for our ever growing world population. In many cases organic farmers have higher cost of production and achieve little or no premium. Organic farmers continually do harm to main stream agriculture in the press and having a foot in both camps gives me the credibility to be able to give a balanced view. Organic food is regularly of inferior quality and is no better for the consumer and in many cases carries toxins such as aspergilla's and mycotoxins. Much organic produce is imported; organic apples from New Zealand emit 10kgs of carbon dioxide per kilo of produce whilst English apples emit 50gms per kilo. Does that make organic apples more sustainable? Personally I think not.

When considering any new diversification project remember that today's niche is tomorrows over supply. Do not be afraid to raise and set prices, calculate your costs accurately, add a margin and do not stray below that figure to chase turnover. Turnover is vanity, profit is sanity, its leftover that counts not turnover I could go on. Reducing ones price is not the only way to stimulate demand. When developing the business, take time to look back from time to time to ensure that your customers are being cared for and your staff happy, because when you start employing lots of people your business is only as good as the last bad experience your customers had with one of your business representatives.

So far I have had an exciting career but it has not been without its tribulations and we have made mistakes: I did chase turnover and neglected profits, I did recruit the wrong staff, and looking back for a year or two, I would have described myself as a busy fool. We did over-stretch ourselves financially, but crucially I recognised that in time and streamlined the business, recruited the right people and made my life not only easier but more profitable.

As farmers we all have opportunities but none of us have a right to a decent living supported by subsidies. It is up to each individual to make their own mark on the industry and create a business that will support your desired standard of living. To my knowledge the UK is the lowest cost producer in, well very little!! That leaves us as rural businesses little option but to differentiate our activities from the commodity producers that most farmers are.

If anyone asks me what I do the answer is still that I am a farmer and it is farming that I still love more than anything. If you have a good idea, act upon it, take good advice and research well and don't make the same mistake I did for a couple of years before I got my act together – don't watch someone else take your idea and make it a success.

Biographical notes

Doug Wanstall was educated at Shuttleworth Agricultural College, and since 1992 has built the family partnership from 650 acres to 4,500 acres, on Romney Marsh in Kent. His enterprises, some still in experimental or development stages, include vegetables, free-range eggs from 20,000 hens and biofuel production converting used oil into bio-diesel. A food processing arm turning based agricultural products into ready meals was established in 2003. In 2001 the farm became a LEAF Demonstration Farm welcoming organised groups and demonstrating how modern, sustainable agriculture operates.