BIOFUELS EXPANSION AND THE LIVESTOCK INDUSTRY IN WESTERN CANADA

by

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Abstract

The continuous expansion of grain based biofuel production poses a complexity of challenges and opportunities for various industries. For the livestock producer in the Prairies, there is the availability of wheat distillers dry grains (DDGS) a by-product of ethanol production which can substitute for high priced grains. Additionally, dependent on market forces, there is the tendency for the importation and use of US corn DDGS. The question of what to feed and when becomes one of utmost significance for livestock producers. This paper analyzes this problem and finds potential positive economic impacts of the availability of DDGS on the livestock industry in western Canada. These impacts are however subject to market forces such as exchange rate and the prices of other feed grains.

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ISSN 1816-2495
www.ifmaonline.org

1.0 Introduction

Although significantly smaller than the United States (US), the biofuel industry in Canada is not exempted from the recent enthusiasm for renewable fuel production. The industry is made-up of 17 plants with a total operating capacity of about 1.45 billion litres per year (Ethanol Producer Magazine 2009). Not unlike other major ethanol producers, grains are the main feedstock used in the production of biofuel in Canada. Geographically, Canadian wheat based ethanol production is predominant in the west and corn based production is mostly in central Canada. The use of these grains creates synergies between the energy and agricultural markets.

For western Canada, the expansion of grain-based ethanol production could have important consequences considering the significance of both the grains and livestock industries in the region. On the one hand, the expansion could increase demand for feed grains, drive up feed grain prices and thereby increase feed costs for livestock producers. Higher grain prices could have unequal sectorial implications, especially on the beef cattle and hog industries which are dependent on the market to set prices.

On the other hand, ethanol is produced in conjunction with valuable by-products (i.e. distillers grains) which can be used in the livestock industry as animal feeds and can substitute for higher priced feed grains in animal rations. Depending on the volumes of distillers grains produced, and the form (i.e. wet or dry) and extent to which they can be incorporated in animal rations, part of the potential increase in livestock feeding costs could be off-set by this by-product. Moreover, given the proximity of western Canada to the US there is the additional possibility of the importation and use of corn DDGS by some feedlot operators in western Canada depending on exchange rates and other cost advantages.

In the light of these issues, this paper examines the competitive implications of the availability of both wheat and corn distillers in the western Canadian feed market. The choice of which type of distillers grains to include in livestock rations is one of key significance for both livestock and ethanol producers. In addition to the potential reduction of feeding cost for livestock producers, a market for distillers grains could be a secondary stimulus for the expansion of ethanol production in the region as margins tighten.

The paper is organized into four sections. The next section presents a review of literature related to the economics of distillers grains inclusion in livestock rations. Section three presents the methodological framework used. Results and discussion are presented in the last section.

2.0 Literature Review

A compendium of studies exist on the on the economic impact of the production of ethanol on the livestock industry. Macro-level studies such as those by Tokgoz et al., (2006), Babcock et al., (2008) and Birur (2008) captured the effect of grain-based ethanol expansion on grain prices. Characteristic of such broad based models however, limited micro-level effects are quantified.

Evidence from farm-level analysis (e.g. Anderson et al., 2008; Vander Pol et al., 2006; Mussell et al., 2007) indicates that the economic impact of the by-product has not been consistent. These conclusions are highly dependent on underlying assumptions of pricing, animal performance, inclusion of other factors such as transportation cost etc. Thus whilst Van der Pol et al., (2006) alluded to positive benefits, results from Anderson et al., (2008) and Mussell et al., (2007) conclude otherwise. Others such as Fabiosa (2008) and Bista et al., (2008) observed positive benefits of feeding DDGS in hog rations.

In a market of continuous price fluidity, estimating the value of a feed ingredient against that of other major substitutes for different prices better enhances producers' decision making. This paper therefore presents an economic valuation of corn and wheat DDGS in a dynamic framework for the hog and beef industries in western Canada.

3.0 Analytical Approach

Least cost rations are formulated for two growth stages (i.e. grower and finisher stages) for hogs and beef cattle. The diet problem entails the selection of the least cost combination of feeds that meet a specified level of nutritional requirement for livestock. An LP model is well-suited to this kind of problem that includes a single performance measure or objective (to minimize feed cost) and constraints (here the nutritional requirements of the animal) (Wachemheim and Mattson 2002).

An LP least cost ration formulation in algebraic terms has the following specification

(Tozer 2000):

$$\text{Minimize T}= \sum_{j=1}^{n} CjXi \tag{1.0}$$

$$\text{Subject to} \sum_{j=1}^{n} aijxj \leq (\geq, =)bj \tag{2.0}$$

$$xj \geq 0 \tag{3.0}$$

Where:

T= total cost of ration

Cj= cost of ingredient j

*X*j= quantity of ingredient j in the ration

aij= the quantity of the nutrient in ingredient j,

bj =the required amount of nutrient *i* in the ration; the equality or inequality of the constraint is determined by the nutrient of interest.

In many applications involving linear application problems, the shadow prices may be at least as important as the solution to the problem. Pesti and Miller (1993) noted that most LP programs provide information indicating the extent to which the cost of a feed ingredient has to fall before it becomes feasible for inclusion in diets. This paper reports these values for DDGS for scenarios when the by-product is not included and the maximum values in cases when optimal. This is to provide an understanding of the economic value of the feed ingredients in the various rations when the prices of other competitive feed ingredients change.

4.0 Data

Table I presents the price data used for analysis. Ten year price averages for various feed ingredients are used. Data is obtained from a variety of sources i.e. USDA Feed Grain Database (2009); Alberta Canola Commission (2009); AFSC (2009) Agriculture and Agri-food Canada (2009); Alberta Department of Agriculture and Rural Development (2009). Since the livestock industry in Western Canada is relatively young there is paucity of price data for wheat DDGS. According to industry sources the price of wheat DDGS is approximately an average of the

Lethbridge feed barley cash price and the F.O.B Vancouver canola meal price[3] (Holman 2009). Hence this price approximation is used.

Table I Descriptive Summary of Price Data

	Price/Tonne	Standard deviation
Barley	156.09	35.73
Canola meal	206.00	46.40
Corn DDGS	163.79	24.12
Barley silage	32.90	7.31
Wheat DDGS	153.13	36.89
• Min	100.05	
• Max	246.44	
Hay	82.31	22.58
• Min	55.35	
• Max	137.85	
Limestone	105.00	
Dicalcium phosphate	900.00	
Field Peas	185.50	
Soybean meal	320.18	
Canola Oil	783.29	

Source: USDA Feed Grain Database (2009); Alberta Canola Commission (2009); AFSC (2009) Agriculture and Agri-food Canada (2009).

5.0 Results and Discussion

Least cost rations for grower and finisher diets for cattle and hog sectors are run using General System Inc.'s Formulation software. Tables II, VII and XII are the specifications for typical western Canadian beef cattle grower, finisher rations and hog grower rations respectively. To capture the scenario of DDGS unavailability base rations are run with the prices of both corn and wheat DDGS at prohibitively high levels. The ethanol by-products are then introduced into the ration at their market levels to assess the impact on feed costs.

[3] Less $45 for rail freight and terminal charges.

Table II Backgrounding Diet Specification

Nutrients	minimum level	maximum level
Crude Protein (%)	13.00	15.50
T.D.N (%)	66.50	69.50
Calcium (%)	0.60	0.80
Phosphorus	0.25	0.40
Barley silage		90

Source: McKinnon (2009)

Table III Beef Cattle Backgrounding Base Ration Results

Ingredient	Percent	Weight	Cost	Low	High
Barley	21.29	35.69	156.09	107.84	166.08
Canola meal	3.49	5.85	206	191.51	1043.34
Limestone	0.58	0.98	105	-97.35	851.07
Barley silage	53.69	90.00	32.90	0	34.87
grass hay	20.95	35.11	82.31	77.09	111.26
Totals	100	167.63	12.73		
			Total Cost=$75.49		
Not selected	Cost	Value			
wheat DDGS	1000	175.11			
corn DDGS	1000	182.09			
Dical Phos	900	15.95			

The base ration (Table III) is predominately barley silage (54%) and barley (21%). The total cost of the diet is $75.49/tonne as fed ($126.53/tonne on DM basis).

The relative shadow values of wheat DDGS and corn DDGS are $175.11/tonne and $182.09/tonne respectively. Given that the actual prices of wheat DDGS and corn DDGS are $153.13/tonne and $163.79/tonne, the latter with its higher energy content seems to represent a

more competitive feed in beef background diets relative to the former. To validate this assertion, the model is re-run with the actual price values of distillers grains under separate scenarios.

Table IV Beef Cattle Backgrounding Ration (Wheat DDGS)

Ingredient	Percent	Weight	Cost	Low	High
Barley	15.95	26.70	156.09	148.66	212.36
Wheat DDGS	10.06	16.83	153.13	11.72	160.84
Limestone	0.62	1.04	105.00	-90.13	1495.69
Barley silage	53.77	90.00	32.90		34.60
grass hay	19.60	32.81	82.31	77.73	108.49
Totals	100.00	167.38	12.52		
			Total cost=$74.77		
Not selected	Cost	Value			
canola meal	206	183.69			
corn DDGS	1000	166.72			
Dical Phos	900	18.74			

The least cost ration is estimated assuming the availability of wheat DDGS. The by-product with its high protein content replaces the protein supplement i.e. canola meal and partly replaces some of the barley (barley reduces from 21.29 to 15.95%) in the base ration. Diet cost however reduces from $75.49($126.53/tonne DM basis) to $74.77 ($125.16/tonne DM basis). Savings made amount to approximately $0.72/tonne ($1.37/tonne DM basis).

5.1 Availability of Corn DDGS

The least cost ration is estimated assuming the availability of corn DDGS. Wheat DDGS is kept at a prohibitively high price. Relative to the results of the base ration (Table III corn DDGS replaces canola meal and the percentage composition of barley also reduces by about 50% (from 21.29% to 10.69%). This is unsurprising considering the relatively higher energy value of corn

DDGS. Diet cost further reduces to $74.43/tonne ($123.15/tonne DM basis), $0.34/tonne ($2.01/tonne DM basis) less than the wheat DDGS diet. Compared to the base ration however, savings on total feed costs amounts to approximately $1.06/tonne ($3.38/tonne DM basis).

Table V Beef Cattle Backgrounding Ration (Corn DDGS)

Ingredient	Percent	Weight	Cost	Low	High
Barley	10.69	17.90	156.09	149.16	242.08
corn DDGS	13.09	21.87	163.79	-214.87	172.11
Limestone	0.64	1.08	105.00	-90.15	1880.88
Barley silage	53.75	90	32.90		34.83
grass hay	21.86	36.61	82.31	77.07	108.84
Totals	100	165.45	12.46		
			Total cost=$74.43		
Not selected	Cost	Value			
canola meal	206	174.09			
Wheat DDGS	1000	150.80			
Dical Phos	900	-426.80			

5.2 Effect of Substitute Feed Prices on the Value of Distillers Grains

From the analysis in the preceding section, it seems that the competitiveness of the distillers co-product is largely dependent on its energy and protein value vis-a-vis other feed ingredients particularly barley and canola meal. To further explore these interactions a price matrix (Table VI) is constructed for the different price ranges of canola meal and barley.

The relative values of wheat and corn DDGS at the various prices are reported in the inner rows and columns. For clarity, the price of the latter is written in brackets. A feed ingredient is included in a least cost ration if its shadow value is equivalent or exceeds its market price value.

The market price of wheat DDGS and corn DDGS used are $153.13 and $163.79 respectively. This implies that at a shadow value equivalent or exceeding these market values, the feed ingredient would be selected as a constituent of the least cost ration. In the present analysis, these inclusion shadow values are italicized and highlighted. Maximum values for corn and wheat DDGS are reported for values that exceed the market value.

It can be deduced that wheat DDGS attains a higher value as canola meal price increases. This pattern is observed at low barley prices. The high protein content of the wheat DDGS ensures that it becomes valuable as its protein substitute in the diet becomes expensive. Considering that the 10-year average price of canola meal was $206/tonne, increased supplies of wheat DDGS in western Canada could have a significant impact on the competitiveness of canola meal. Corn DDGS has a lower shadow value at lower price levels of barley (<$160/tonne).

Given the price of canola meal, as the price of feed barley increases, the value of corn DDGS increases and replaces wheat DDGS as price of the latter falls below its market value. The price matrix further confirms the higher economic value of corn DDGS relative to wheat DDGS in beef cattle backgrounding rations[4]. The price matrix also confirms the absence of complementarity between the by-products as none of the price combinations had both ingredients simultaneously reaching its market value.

The price analysis suggests interdependencies among values of the feed ingredients. This is a consequence of the high rate of substitutability among feed ingredients. Further, the present analysis indicates that the economic value of distillers by-product in a feed ration varies depending on the price and nutritional value of other nutrients.

[4] Indicated by the number of barley-canola meal combinations at which the value of corn exceeds wheat distillers grains.

Table VI Effect of Substitute Feed Prices on the Value of Distillers Grains in Beef Backgrounding Diets

	Price of Canola Meal				
	140	160	180	200	220
Price of Feed Barley 120	124.19 (129.32)	143.89 (143.10)	***163.60*** (149.56)	***173.49*** (149.56)	***173.49*** (149.56)
140	127.90 (139.33)	139.10 (148.88)	***155.78*** (159.07)	***159.88*** (159.07)	***159.88*** (159.07)
160	131.94 (149.50)	143.47 (159.05)	149.19 (***167.06***)	149.19 (***167.06***)	149.19 (***167.06***)
180	135.99 (159.68)	140.95 (***169.23***)	140.95 (***173.88***)	140.95 (***173.88***)	140.95 (***173.88***)
200	132.71 (169.86)	132.71 (***179.41***)	132.71 (***180.71***)	132.71 (***180.71***)	132.71 (***180.71***)
220	124.47 (***180.04***)	124.47 (***187.53***)	124.47 (***187.53***)	124.47 (***187.53***)	124.47 (***187.53***)
240	116.23 (***190.22***)	116.23 (***194.36***)	116.23 (***194.36***)	116.23 (***194.36***)	116.23 (***194.36***)
260	108.00 (***201.18***)	108.00 (***201.18***)	108.00 (***201.18***)	108.00 (***201.18***)	108.00 (***201.18***)

5.3 Beef Finisher Rations

The analysis presented in the previous section is repeated for the finishing rations. Unlike the backgrounding diets, the base ration (Table VIII) is predominately grain based with higher energy content. The cost of the finishing cattle base ration is approximately $122.60/tonne ($166.057/tonne DM basis).

With the introduction of wheat DDGS into the ration (i.e. Table IX), the cost of feed is reduced by $1.06/tonne ($1.26/tonne DM basis[5]) as part of the feed barley in the ration is replaced by the by-product. Juxtaposing this against the case of the backgrounding diet, it is obvious that the savings are lower in the finishing ration relative to the backgrounding diet.

Table VII Beef Cattle Finisher Ration Specification

Nutrients	minimum level	maximum level
Crude Protein (%)	11.50	16.0
T.D.N (%)	78.00	
Calcium (%)	0.50	
Phosphorus	0.250	
Barley silage		90

Source: McKinnon (2009)

Table VIII Finishing Cattle Base Ration

Ingredient	Percent	Weight	Cost	Low	High
Barley	72.34	97.98	156.09	114.85	164.40
Limestone	0.82	1.11	105	-110.26	759.65
Barley silage	26.85	36.36	32.90	22.70	34.70
Totals	100	135.45	16.16		
			Total Cost=$122.60		
Not selected	Cost	Value			
Wheat DDGS	1000	160.93			
Canola meal	206	193.68			
Corn DDGS	1000	173.02			
Grass hay	82.31	77.48			
Dical Phos	900	10.20			

[5] $166.057-$164.80/tonne DM basis

Table IX Finishing Cattle Ration (Wheat DDGS)

Ingredient	Percent	Weight	Cost	Low	High
Barley	59.81	81.09	156.09	148.58	205.37
Wheat DDGS	11.98	16.24	153.13	11.71	160.93
Limestone	0.78	1.05	105.00	-107.40	1424.78
Barley silage	27.44	37.20	32.90	15.28	34.60
Totals	100	135.59	16.48		
			Total Cost=$121.54		
Not selected	Cost	Value			
Canola meal	206	185.65			
Corn DDGS	1000	167.52			
Grass hay	82.31	77.73			
Dical Phos	900	11.58			

Reductions in feed ration cost is higher with the introduction of corn DDGS (Table X)- approximately $7.29/tonne ($2.13/tonne DM basis) as the cost of diet reduces to $115.31/tonne ($163.93/tonne DM basis) from the base scenario of $166.06/tonne DM basis. It appears that the higher energy value of corn DDGS enables it to replace greater proportions of barley in finishing rations thereby reducing feed costs.

Table X Finishing Cattle Ration (Corn DDGS)

Ingredient	Percent	Weight	Cost	Low	High
Barley	49.22	69.98	156.09	148.49	1304.81
Corn DDGS	16.21	23.04	163.79	67.85	173.02
Limestone	0.77	1.1	105	-105.04	1524.45
Barley silage	33.80	48.05	32.90	-22.30	34.55
Totals	100	142.17	16.39		
			Total Cost= $115.31		
Not selected	Cost	Value			
Wheat DDGS	1000	147.83			
Canola meal	206	180.20			
Dical Phos	900	12.52			
Grass hay	82.31	77.90			

5.4 Effect of Substitute Prices (Finisher Ration)

The price matrix (Table XI) shows a common trend of rigidity in the value of wheat DDGS across several rows of price combinations. As a result of the higher energy requirements for finishing rations, the shadow value of wheat DDGS is low; ranging from $67.07 at low canola meal-high barley price combinations to $145.16 in high price canola- average price barley combinations. This notwithstanding, similar deductions of a higher protein value of wheat DDGS can be made[6].

Relative to backgrounding rations however, it seems that corn DDGS has a higher economic value in finishing rations as shown by the high values of the by-product at high price levels of canola meal and barley. Moreover, none of the price combinations yielded a shadow value for wheat DDGS that was equivalent to its market value. It can therefore be deduced that the availability of Corn DDGS has a greater impact on the competitiveness of wheat DDGS in beef cattle finisher diets relative to backgrounding diets.

[6] As shadow values generally tend to increase across rows and decrease along the columns.

Table XI Effect of Changes in Substitute Feed Grain Prices on the Value of Distillers Grains in Beef Cattle Finishing Diets

	Price of Canola Meal				
	140	160	180	200	220
Price of feed Barley					
120	123.24 (129.05)	123.41 (129.17)	123.41 (129.17)	123.41 (129.17)	123.41 (129.17)
140	115.22 (133.04)	134.66 (146.74)	144.21 (153.47)	144.21 (153.47)	144.21 (169.83)
160	107.20 (137.03)	126.63 (150.73)	145.16 (***164.43***)	145.16 (***169.41***)	145.16 (***169.41***)
180	99.17 (141.02)	118.61 (154.72)	131.47 (***168.42***)	131.47 (***179.05***)	131.47 (***179.05***)
200	91.15 (145.01)	110.58 (158.71)	117.79 (***172.41***)	117.79 (***186.11***)	117.79 (***188.70***)
220	83.12 (149.00)	102.56 (162.70)	104.10 (***176.40***)	104.10 (***190.10***)	104.10 (***198.34***)
240	75.10 (152.99)	90.42 (***166.69***)	90.42 (***180.39***)	90.42 (***194.09***)	90.42 (***207.79***)
260	67.07 (156.98)	76.73 (***170.68***)	76.73 (***184.38***)	76.73 (***198.08***)	76.73 (***211.78***)

5.5 Hog Rations

The analysis conducted in the previous section is repeated for hogs. Table XIII shows the hog grower base ration. Feed wheat and field peas are the dominant feed ingredients used. Canola meal serves as a supplementary protein source, complementing the lower levels of methionine and cystine in peas (Hickling 2003). The availability of field peas ensures that the shadow value of soybean meal is lower than its market value. The total feed cost of the ration is $174.42/tonne.

Table XII Hog Grower Diet Specification

Nutrients	minimum level	maximum level
Crude Protein (%)	16	18
DE Swine KC/KG	3150	
Calcium (%)	0.80	
Phosphorus (%)	0.650	
Lysine (%)	0.850	
Canola meal (%)		12.00
Corn DDGS (%)		18.00
Soybean meal		
Limestone (%)		3
Canola oil (%)		3
Wheat DDGS		18.00

Source: Racz (2010)

Table XIII Hog Grower Base Ration

Ingredient	Percent	Weight	Cost	Low	High
Feed wheat	59.51	59.51	153.19	135.76	156.50
Canola meal	12.00	12	206	0	220.48
Peas	24.36	24.36	185.50	173.64	224.30
Limestone	3.00	3	105	0	128.66
Dical Phos.	1.13	1.13	900	511.69	2202.79
Totals	100	100	17.44		
			Total Cost=$174.42		
Not selected	Cost	Value			
barley	156.09	152.77			
wheat DDGS	1000	180.18			
Soybean meal	320.18	232.77			
Corn DDGS	1000	177.68			
Canola oil	783.29	128.66			

With the availability of wheat DDGS (Table XIV), canola meal is displaced from the diet and the percentage of feed wheat significantly reduced. Barley enters the diet at a high percentage of 44 per cent. The composition of feed peas also increase to make-up for the lower protein (wheat DDGS relative to canola meal) and energy value of wheat DDGS. It can be observed that the economic value of wheat DDGS in the diet is dependent on the prices of other feeds such as field peas.

Table XV, shows the corn DDGS based diet, as a protein or energy feed, the co-product replaces most of the canola meal in the base ration and a proportion of feed wheat. Diet cost reduces to $173.56/tonne. It can therefore be deduced from the preceding analysis that feeding the co-product can reduce hog grower feeding cost by $0.86/tonne and $1.63/tonne for the corn DDGS and wheat DDGS based diets respectively.

Table XIV Hog Grower Ration (wheat DDGS)

Ingredient	Percent	Weight	Cost	Low	High
Wheat	0.21	0.21	153.19	152.87	155.47
Barley	44.61	44.61	156.09	154.38	156.44
Wheat DDGS	17.89	17.89	153.13	122.39	155.69
Peas	33.07	33.07	185.50	177.76	188.80
Limestone	3.00	3.00	105	0	140.52
Dical Phos	1.22	1.22	900	755.28	1031.61
Totals	100	100	17.28		
			Total Cost=$172.79		
Not selected	Cost	Value			
Canola meal	206	202.42			
Soybean meal	320.18	208.40			
Corn DDGS	1000	160.45			
Canola oil	783.29	150.30			

Table XV Hog Grower Ration (Corn DDGS)

Ingredient	Percent	Weight	Cost	Low	High
Wheat	44.86	44.86	153.19	152.45	153.71
Canola meal	0.61	0.61	206.00	205.29	220.48
Peas	32.30	32.30	185.50	173.64	186.33
Corn DDGS	18.00	18.00	163.79	0	164.44
Limestone	3.00	3.00	105.00	0	141.74
Dical Phos	1.23	1.23	900.00	511.69	941.74
Totals	100	100	17.36		
			Total Cost=$173.56		
Not selected	Cost	Value			
Barley	156.09	155.06			
Soybean meal	320.18	213.92			
Wheat DDGS	1000	159.33			
Canola oil	783.29	150.30			

5.6 Effect of Substitute Prices (Hog Grower)

The price matrix constructed for cattle is repeated for hogs. In this section however, the resultant values of wheat DDGS and corn DDGS in response to changes in the prices of field peas and feed wheat prices are examined- the two appear to be the dominant feeds in hog rations.

From Table XVI it can be observed that across rows the shadow value of wheat DDGS shows little variation, aside initial reductions in shadow values at low values of feed wheat. Similar trends can be observed across rows for corn DDGS. This is expected because the restrictions placed on the percentage of distillers grains in the diet make them a protein source. Feed wheat is primarily an energy source and hence changes in its price seem to have a limited effect on the value of distillers grains- especially when feed barley is also available.

The relatively high shadow value of wheat DDGS at average price values of field peas, indicate that the presence of field peas enhances the economic value of the by-product. However, as the price field peas continues to increase (price range $240-$260/tonne), the shadow value of wheat DDGS reduces from $132.22 to 89.01/tonne. This reduction in value may largely be a result of the availability of other protein feed substitutes such as soybean meal and canola meal that become economically valuable as field peas become increasingly expensive. Corn DDGS is generally less competitive in hog rations and come into the diet at high price levels of field peas (>$200/tonne) to provide supplemental protein and energy once field peas are priced out.

Table XVI Effect of Changes in Substitute Feed Grain Prices on the Value of Distillers Grains in Hog Grower Rations

	Price of Feed Wheat			
	140	160	200	220
Pea Price				
120	94.69 (112.36)	82.50 (106.25)	82.50 (106.25)	82.50 (106.25)
140	150.38 (150.12)	129.22 (139.51)	129.22 (139.51)	129.22 (139.51)
160	***163.19*** (154.27)	***162.04*** (157.89)	***162.04*** (157.89)	***162.04*** (157.89)
180	***153.75*** (159.08)	***158.75*** (160.07)	***158.75*** (160.07)	***158.75*** (160.07)
200	***160.55*** (159.08)	***155.78*** (162.03)	***155.78*** (162.03)	***155.78*** (162.03)
220	***156.76*** (161.48)	152.46 (***164.24***)	152.46 (***164.24***)	152.46 (***164.24***)
240	132.22 (150.61)	149.14 ***(166.44***)	149.14 (***166.44***)	149.14 (***166.44***)
260	89.01 (125.59)	148.84 (***166.48***)	148.84 (***166.48***)	148.84 (***166.48***)

5.7 Influence of Market Factors

This paper assesses the effect of variations in exchange rate on the competitiveness of the two types of distillers grains. Given the freight cost of $50/tonne and the domestic price of corn DDGS, the price of the by-product (delivered) i.e. $163.79 corresponds with a mean exchange rate of CAN$1.27/US$ (0.79 US$/CAN$). The corresponding least cost ration is reported in Table XVII.

Table XVII Beef Cattle Ration Results at the Exchange of 0.79 US$/CAN$

Ingredient	Percent	Weight	Cost	Low	High
Barley	10.69	17.90	156.09	150.42	401.56
corn DDGS	13.09	21.87	163.79	-214.90	165.72
Limestone	0.64	1.08	105.00	-90.16	1042.59
Barley silage	53.75	90	32.90	0	34.83
grass hay	21.86	36.61	82.31	77.07	93.52
Totals	100	165.45	12.46		
			Total cost= $74.43		
Not selected	Cost	Value			
canola meal	206	174.09			
Wheat DDGS	153.13	150.80			
Dical Phos	900	-426.80			

As the Canadian dollar depreciates i.e. $0.79 to $ 0.76 the price of corn distillers grains increases from $163.79/tonne to $166.73/tonne. Priced at this level, corn DDGS becomes less competitive and is displaced from the diet by wheat DDGS. Table XVIII reports the resultant least cost ration. It can be deduced that a weaker dollar seems to enhance the competitiveness of wheat DDGS and vice versa.

Table XVIII Beef Cattle Ration Results at the Exchange of 0.76 US$/CAN$

Ingredient	Percent	Weight	Cost	Low	High
Barley	15.95	26.70	156.09	148.66	156.11
Wheat DDGS	10.06	16.83	153.13	11.71	153.14
Limestone	0.62	1.04	105.00	99.66	1495.59
Barley silage	53.77	90.00	32.90	0	34.60
grass hay	19.60	32.81	82.31	82.26	108.49
Totals	100	167.38	12.52		
			Total cost= $74.77		
Not selected	Cost	Value			
canola meal	206	183.69			
Corn DDGS	166.73	166.72			
Dical Phos	900	18.73			

6.0 Conclusions

From the analysis, the availability of distillers grains in the western plains could impact positively on the livestock industry. Additionally, the competitiveness of corn DDGS in beef cattle rations relative to wheat DDGS can be observed. Even within the beef cattle sector, the unequal impact of corn DDGS is evident as cattle finisher operations would tend to benefit more relative to backgrounding. Alternatively, wheat DDGS seems to be more competitive in hog rations. The general pattern is that wheat distillers grains may be more competitive in high protein diets and are more economical when the price of protein feed ingredients such as canola meal increases. The reverse holds for corn DDGS whose economic value seems to be tied to its energy value. Wheat DDGS marketers may therefore enhance their profitability by targeting the high-protein segment of the feed market.

For the livestock producer, the key point is that, the economic value of distillers grains varies relative to the prices substitute feeds in both hog and cattle rations. An understanding of these dynamics is essential to reaping maximum benefit from the ethanol boom. Furthermore, market factors particularly exchange rates affects the competiveness of both wheat and corn DDGS. A stronger Canadian dollar tends to accentuate the economic value of the latter relative to the former. The recent increases in the value of the Canadian dollar (0.94$/CAN) and the surge in corn DDGS imports into southern Alberta and other parts of western plains seems to confirm this observation (Boaitey 2010). The continuous expansion of US grain-based ethanol production is therefore likely to impact the feed grains market in western Canada as favourable market conditions persist.

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