REFEREED ARTICLE

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Economic benefits of extending the grazing season in beef cattle production in Atlantic Canada

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ABSTRACT

Today, feeding cost is a significant issue for the economic viability of livestock operations, including beef production. The aim of this study was to determine, in comparison to the conventional feeding approach, the advantages and expected value of extending the grazing season in Atlantic beef production using stockpiled and baled forage. The research methodology is based on the partial budgeting approach. The study shows that extending the grazing season can reduce by 54% the total annual production cost for feed, yardage and straw bedding. Indeed, this innovative feeding approach can contribute to avoiding expenses of $7,331.92 per farm per year through eliminating and/or reducing overwintering costs for feed (16%), yardage (55%) and straw bedding (29%). A detailed analysis shows a saving of $0.92 of the overwintering production costs per cow/calf pair per day. Moreover, extending the grazing season does not seem to compromise animals' performance. This practice could therefore be an alternative solution to enhance beef farm financial viability and can also contribute to the sustainable development of beef farms through other services provided such as recreation functions and environmental protection. These results reflect the necessity of supporting and promoting the adoption of extended grazing season practices in Atlantic beef production.

KEYWORDS: beef production; extending the grazing season; economic benefits; Atlantic Canada

1. Introduction

Many research studies have been done in Canada related to grazing systems and how they could be better employed for cattle feeding. Particularly in Western Canada, several research studies focused on beef feeding strategies are trying to determine how beef production could be conducted more economically and sustainably by reducing production costs and environmental impacts (Kaliel, 2004; Baron *et al.,* 2014; Baron and McCartney, 2014). These research studies show that innovative feeding strategies under the general description of 'extending the grazing season' can be an alternative solution to enhance beef farm viability in Canada. However, extending the grazing season is used less in Atlantic beef production, where farmers continue to employ a conventional feeding approach, which consists of raising animals on pasture during summer and feeding them in the barn the rest of the year. Beef production researchers and specialists are currently conducting research on extending the grazing season in Atlantic beef production, while taking into account the unique weather conditions in the region.

Indeed, in Canada, as in many developed countries, government support to agricultural production remains one part of farmers' income. One reason for this may be the incapacity of livestock systems to be financially autonomous and could be due to low return on investment in a context of high operational production costs, including feed cost (Lachapelle, 2014). The viability issue in livestock farming may also stem in part from environmental issues (Arsenault, Tyedmers and Fredeen, 2009), animal welfare (Martelli, 2009; Harper and Makatouni, 2002), food quality concerns (Boval and Dixon, 2012) and the perception of livestock production in society (Beauchemin *et al.,* 2010). This study will mainly focus on the financial viability issue.

Animal feed represents the largest input cost for livestock and poultry producers, up to 75 percent of the total cost depending on the species. The use of production systems with low or lower feeding costs could therefore

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contribute to improved financial viability of livestock farming. Particularly in beef cattle production, the efficient use of grazing systems with good management practices can contribute to reduced production costs and enhanced beef farm viability in Canada (Kaliel, 2004; McCartney *et al.,* 2004). In fact, extending the grazing season in beef cattle production can eliminate feed storage and manure removal and spreading costs, reduce the use of tractors, reduce labour cost for animal feeding and improve soil fertility (Baron *et al.,* 2014; Kaliel, 2004; McCartney *et al.,* 2004).

This study aims to integrate economic, forage agronomy, and livestock production data to determine the economic costs and benefits of management techniques that extend the grazing season for Atlantic beef producers. In turn, this information allows us to identify which feeding system is most efficient for Atlantic beef farm viability; the efficiency of a system or a plan being its capacity to allow output at a lower cost.

2. Background on Approaches to Extending the Grazing Season

According to D'Souza *et al.* (1990), extending the grazing season is a management system in which the usual grazing season is lengthened by utilization of hay fields for pasture. It may also consist of the use of the stockpiling of perennial forages (Peterson *et al.,* 2001). Extending the grazing season increases the number of days animals are fed on pasture and reduces the number of feeding days in the barn. This approach requires the herd manager to take early actions to identify and plan the appropriate strategies; it cannot be an impulsive decision to leave the animals grazing for a longer period of time. In Canada, the different strategies to extend the grazing season can be grouped under three main methods: stockpiled grazing; swath grazing; and bale grazing.

Stockpiled grazing is summer forage regrowth which is saved for use as fall and winter pasture. It may replace part or all of the hay, straw or silage needed for winter feeding of beef cattle and can be an important part of a cattle producer's production system (Baron and McCartney, 2014). The stockpiled grazing method requires very low inputs through elimination of costs related to harvesting of hay and reduced labour for feeding and manure handling. Stockpiled grazing is economically interesting in the sense that animals feed themselves and also spread manure themselves, which means a considerable saving on labour and machinery costs (Hamilton, 2012). However, the use of the stockpiled grazing method is limited in time, in the sense that it is not beneficial to stockpile the forage for a long period before the animals consume it. Indeed, if left for a long time before grazing, the stockpiled forage loses its nutritive quality in response to growth and emergence of fibrous elements (Perennia, 2010), and in response to rain and snowfall during winter. Stockpiled grazing presents benefits in Atlantic Canada to extend the grazing season at low cost in a part of the year where rain and snowfall are not very frequent, usually from mid-autumn to early winter.

Swath grazing is another management practice that can be used to extend the grazing season and reduce feed, labour and manure handling costs for cattle producers. Swath grazing is practiced more commonly in Western Canada, where it is considered as the main method to extend the grazing season and reduce cattle overwintering costs (Baron *et al.,* 2014; Baron *et al.,* 2012). However weathering caused by late fall and winter precipitation, in conjunction with snowmelt, substantially reduces the nutritive value of swathed material (Aasen *et al.,* 2004). For this reason, in Atlantic Canada, where rains are very common during autumn and winter, swath grazing is less suitable as a method to extend the grazing season.

Bale grazing is the practice of placing large quantities of bales out for livestock in the fall and regulating access and intake during the winter. It is also called extensive bale grazing, in contrast to intensive bale grazing which consists of feeding animals with baled forage in a confined area. If swath grazing appears to be the main method of extending the grazing season in Western Canada by reason of its productivity and nutritive value (Baron *et al.,* 2014), bale grazing appears to be the method of choice for extending the grazing season in the Atlantic region. Indeed, in Atlantic Canada, bale grazing has the most benefits as it is mostly likely to maintain forage nutritive value during winter. The relative benefits of the three methods, in Atlantic Canada, are summarized in Table 1 below.

In general, the stockpiled grazing method is the one which requires the least inputs among the three methods, as more inputs are needed for swath and bale grazing methods to swath and harvest the forage. Compared to swath grazing, bale grazing also requires more inputs due to bale handling, during both harvest and feeding. Of the three methods, the most economical is swath grazing due to its high productivity level, followed by stockpiled grazing due to its very low input requirement.

In summary, bale grazing and stockpiled grazing have complementary benefits in Atlantic Canada. Bale grazing is mostly likely to provide feed with good nutritive value to the animals. Stockpiled grazing's main benefit is its lower cost during mid-autumn to early winter. The combination of these two extended grazing approaches appears to be a good way to extend the grazing season in Atlantic Canada. For this study, as shown in the following schema (Figure 1), extending the grazing season with stockpiled and baled forages is considered the alternate beef feeding plan in Atlantic Canada. This study will compare this alternate feeding plan to the conventional feeding plan in the study area and will determine the most economically beneficial plan for beef farmers in Atlantic Canada.

Table 1: Benefits of extended grazing season methods in Atlantic Canada

Stockpiled grazing Benefits			Swath grazing Benefits			Bale Grazing Benefits		
Inputs	Productivity	Nutritive value	Inputs	Productivity	Nutritive value	Inputs	Productivity	Nutritive value
+++	++	++	++	+++	++	+	++	+++

+ = least benefits; ++ = mean benefits; +++ = most benefits

Figure 1: Schema for extending the grazing season for beef production in Atlantic Canada

3. Methodology

The research methodology is based on the partial budgeting approach. Partial budgeting is an economic analysis approach to farm management which aims to estimate the change that will occur in farm profit or loss from some change in the farm plan by considering only those items of income and expense that change (Boehlje and Eidman, 1984). A partial budgeting approach does not calculate the total income and total expense for each of two plans, but considers only the changes that can create profit or loss for farmers. Partial budgeting is particularly useful in analysing relatively small changes in the farming system, such as changes in the feeding plan, the purchase of a piece of equipment to replace hiring a custom operator, participation in a government program, or a change in production planning (Boehlje and Eidman, 1984).

This study focuses on production costs only, so the analysis will be a 'partial budgeting of production costs'. The analysis will consist of estimating the change that will occur in farm profit by considering only those expense items that change. It is assumed that incomes are equal for the two feeding plans. The two feeding plans refer to a plan based on extending the grazing season (Figure 1) and a plan based on the common feeding approach followed by Atlantic beef farmers. The idea is to characterise, through a case study, the use of extending the grazing season in Atlantic beef production by comparing it to the common beef feeding approach in the study area. Financial data used were obtained from estimates of farm production costs in Atlantic Canada (Jones, 2011; 2013; PEI Cattle Producers, 2013) and from studies carried out in western Canada (Saskatchewan Forage Council, 2011; Manitoba Agriculture Food and Rural Development, 2015) when data for Atlantic Canada was not available.

In addition to the partial budgeting of farm production costs, the animals' performance is also analysed under extended grazing season practices in Atlantic Canada. The data used to calculate animal performance comes from the Nappan Research Farm (NRF), one of Agriculture and Agri-Food Canada's research facilities specialising in beef production research in the Atlantic region. Because extending the grazing season is not yet well developed in the Atlantic region, the idea is to verify that this feeding approach does not compromise animals' performance. This calculation will also contribute to verifying the validity of the assumption that the two feeding plans should result in the same incomes. Indeed, the use of extending the grazing season in Western Canada has proven successful in terms of output compared to conventional practices (Kelln *et al.,* 2011; Baron *et al.,* 2014; McCartney *et al.,* 2004).

4. Results

Partial Budgeting of Beef Farm Production Costs in Atlantic Canada

In order to determine the value of reduced and/or additional expenses, an Excel spreadsheet was used for an annual partial modelling of beef farm production costs (Table 2). This partial modelling considers the two feeding plans discussed above. The conventional feeding approach represents the base plan; the extended grazing season feeding plan represents the alternate plan.

The modelling approach is based on a farm with 40 cow/calf pairs and 40.5 ha (100 acres) of farmland, including 24.3 ha for pasture (grazing) and 16.2 ha for forage hay production. These values correspond to the mean values in the study area (Jones, 2013). The 'parameters per cow/calf' are expressed per year except yardage cost which is expressed per day. The modelling strategy considers four components for each feeding plan: herd characteristics; feeding periods; production costs; and other costs. The effective cost of different items for each feeding period is estimated from published data for the region, and published data for western Canada where data for Atlantic Canada is unavailable.

The herd characteristics component includes stocking rate, carrying capacity, number of cow/calf pairs, available hectares (ha) for pasture and available hectares for hay production. Stocking rate is defined as the number of animal units per 0.405 ha over a given period of time, while the carrying capacity is the maximum long-term stocking rate possible without detrimental effects on the land resource (Mark and Matthew, 2007). For this study the stocking rate is represented as the number of ha utilized by one cow/calf pair to facilitate calculations, as most cost of production parameters are expressed in dollars per unit of area utilized. The stocking rate corresponds to 0.607 ha of pasture per cow/calf pair and 0.405 ha of produced hay per cow/calf pair when they are not grazing. The carrying capacity is assumed to be the same as the stocking rate in the calculations.

The feeding periods are subdivided according to each feeding plan. For the extended grazing season feeding plan, the feeding year is subdivided into three periods: 165 days of extensive stockpiled grazing from mid-May to the end of October; 75 days of winter feeding on intensive stockpiled grazing from November to mid-January; and 125 days of winter feeding on bale grazing from mid-January to mid-May (Figure 1). This subdivision of feeding periods takes into consideration Atlantic weather conditions and the possibility to capitalise on extended grazing season approaches for winter feeding. For the conventional feeding plan, the feeding year is subdivided into two periods: 165 days extensive stockpiled grazing from mid-May to the end of October; and 200 days of barn feeding with baled hay from November to mid-May. As the summer period has the same characteristics for the two feeding plans, it has not been considered in the analysis as it does not bring any change in the comparison of costs for the two plans.

The production costs component refers to feed, yardage and straw bedding costs associated with the different feeding periods for each feeding plan. In general, farm production costs can be classified as direct and indirect

Table 2: Annual partial modeling of annual beef farm production costs for two feeding plans in Atlantic Canada

Components			Parameter per cow/calf	Conventional feeding plan	Extended grazing season feeding plan
Herd Characteristics	Stocking rate			0.607ha/pair	0.607 ha/pair
	Carrying capacity			0.607ha/pair	0.607 ha/pair
	Number of cow/calf pairs			40	40
	Surface for pasture		0.607 ha	24.3 ha	24.3 ha
	Surface for production of hay or baled hay forage		0.405 ha	16.2 ha	16.2 ha
Feeding Periods	Summer pasture days			165	165
	Winter pasture days on stockpiled grazing			0	75
	Winter pasture days on bale grazing			0	125
	Total of pasture days			165	365
	Number of days in barn			200	0
	Total feeding days		365	365	365
Production Costs	**Stockpiled Grazing** **Bale Grazing** **Summer Grazing** **Non-Grazing Season**	Pasture cost Salt and Mineral Yardage cost Bale hay cost Salt and Mineral Yardage cost As the summer period has the same characteristics for the two feeding plans, it has not been considered in the analysis. Hay cost Salt and Mineral Concentrate feed Yardage cost Straw bedding cost	$120.00 $25.00 $0.36 $282.00 $25.00 $0.40 $282.00 $20.00 $0.00 $0.90 $55.16	 $6,180.82 $438.36 $0.00 $7,200.00 $2,206.40	$986.30 $205.48 $1,080.00 $3,863.01 $342.47 $2,000.00
Subtotal (1) = Reduced Expenses = (a) - (b) = $7,548.32				**$16,025.58 (a)**	**$8,477.26 (b)**
Other Costs	Wind Break cost		$1.5	$0.00	$60.00
	Training on management skills cost			$0.00	$40.00
	Pasture watering system		$2.91	$0.00	$116.40
Subtotal (2): Additional Expenses = (d) - (c) = $216.40				**$0.00 (c)**	**$216.40 (d)**
Total				**$16,025.58**	**$8,693.66**

costs (Saskatchewan Forage Council, 2011). Direct costs include feed, bedding, minerals and supplements and veterinary expenses. Indirect costs refer to yardage costs, including manure removal cost. According to Saskatchewan Forage Council (2011), yardage cost is '*an expression of indirect costs including ownership (depreciation, housing, insurance and interest costs) and operating costs of facilities, repair and maintenance of machinery and equipment, fuel, labour, management, utilities, property tax and general and administrative costs. These costs are often charged as head days fed or grazed*'. For this study, veterinary cost is not considered as it is assumed equal for the two feeding plans. Indeed, if extending the grazing season reduces veterinary intervention it also increases the use of deworming as grazing animals can have increased gastrointestinal parasites. The feed costs, provided by Jones (2011; 2013), are costs for pasture forage, baled hay forage, salt and minerals. The cost of improved pasture forage was estimated at $80 per 0.405 ha per year (Jones, 2013). Therefore, by considering 0.607 ha per cow/calf on pasture and a farm size of 40 cow/calf pairs, the pasture cost is $986.30 for the stockpiled grazing period. The cost of baled hay per cow/calf pair per year was estimated at $282 (Jones, 2011), so the total baled hay cost is $3,863.01 for the bale grazing period and $6,180.82 for the non-grazing period. From Jones (2013), the cost for salt and mineral was estimated at $25 per cow/calf pair per year, so $205.48 for the stockpiled grazing period, $342.47 for the bale grazing period and $438.36 for the non-grazing period. Yardage cost for different feeding periods is estimated from a study carried out in western Canada (Saskatchewan Forage Council, 2011). The estimated values per cow/calf per day are $0.36 for stockpiled grazing, $0.40 for bale

grazing and $0.90 for the non-grazing season. This leads to a respective yardage cost of $1,080.00 for the stockpiled grazing period, $2,000.00 for the bale grazing period and $7200 for the non-grazing period. The straw bedding cost is the amount spent to purchase bedding used to feed animals in the barn during winter. This cost, estimated at $55.16 per cow/calf pair per year, was obtained from a report on Prince Edward Island (PEI) cost of production (PEI Cattle Producers, 2013). For 40 cow/calf pairs, straw bedding cost corresponds to $2,206.40 per year. Straw bedding is no longer required under the extended grazing season feeding plan given the fact that animals are raised completely on pasture, so this is an expense item avoided in the alternate feeding plan.

The last component refers to additional indirect costs associated with the alternate plan. This includes the costs for windbreak, pasture watering system and training on management skills. Apart from the cost for training on management skills, the two other costs were estimated from a study carried out in western Canada (Manitoba Agriculture Food and Rural Development, 2015). For the windbreak, the data shows that it could cost up to $2.91 per cow per year. However, given the physical characteristics of the Atlantic region with a lot of trees that can potentially play the role of windbreak, farmers should not have to spend much money on a windbreak. The value of a windbreak was estimated at $1.50 per cow/calf per year, which equals to $60 for 40 cow/calf pairs per year. The watering system cost was estimated from western Canada data at $2.91 per cow per year, a total amount of $116.40 for 40 cow/calf pairs per year. The cost for training on management skills was estimated at $40 as a reasonable cost per farmer per year to develop skills on grazing management and strategies to extend the grazing season. We assume this training hosted by the local beef farmers' association using the participation fees of each member.

This partial modelling of beef farm production costs shows two important outputs: subtotal (1) and subtotal (2). Subtotal (1) refers to expenses for the conventional feeding plan that will be avoided by extending the grazing season. Subtotal (2) refers to additional expenses from the extended grazing season feeding plan that are not required with the conventional feeding plan. These results are summarised in Table 3.

Table 3: Partial budgeting of beef farm production costs in Atlantic Canada

1. Reduced Expenses = Subtotal (1) = $7 548.32
2. Additional Expenses = Subtotal (2) = $216.40
3. Difference (1-2) = $7,331.92
This indicates that the net financial benefit of the alternate plan exceeds the net financial benefit of the base plan.

Beef Performance Under an Extended Grazing Season Scenario

The performance of beef cattle under extended grazing season conditions were analysed through calculation of their average body weight (BW) and body condition scores (BCS) while on bale grazing at NRF. The available data obtained from NRF were animals' BW and BCS at the time they began the bale grazing period and again when the bale grazing period ended. These data were used to calculate the average daily weight gain and the average rate of change in body condition scores. Animals were bale grazed during three successive winter periods: the first period with 68 beef cattle from December 11, 2013 to February 24, 2014; the second period with 61 beef cattle from December 16, 2014 to March 09, 2015; and the third period with 59 beef cattle from December 29, 2015 to March 08, 2016. For all three grazing periods, animals were introduced on bale grazing while they were in the middle of pregnancy. The scale used for BCS at NRF is 1-9 points and the calving period is during the spring, usually in April or early May. The results are summarised in Table 4.

5. Discussion

This section discusses the results of the economic analysis of extending the grazing season in Atlantic beef production. The results show that extending the grazing can contribute to reducing farm production costs, and demonstrate that beef cattle are able to maintain good performance under an extended grazing season system in Atlantic Canada. These results are discussed below.

Extending the Grazing Season Contributes to Reducing Beef Production Costs

Comparing the total annual partial budget cost of $16,025 for the base plan and $8,693 for the alternate plan (Table 2), there is a reduction of 54% of the annual partial budget cost allowed by the alternate plan. Indeed, the alternate plan can contribute to avoiding an expense of $7,331.92 per farm per year through eliminating and/or reducing the overwintering costs for feed (16%), yardage (55%) and straw bedding (29%) (Figure 2).

With the extended grazing season feeding plan, animals are raised completely on pasture, which means that a farmer will no longer need to spend $2,206.40 per year for straw bedding. Keeping animals on pasture also offers the opportunity for Atlantic beef farmers to save

Table 4: Animal Body Weight (BW) gain and BCS change under winter bale grazing in Atlantic Canada

Periods		Animal head	Average weight	Average BCS
1st Period (65 days)	Put into bale grazing	68	1574.5	7.2
	Taken out of bale grazing	68	1582.5	5.9
	BW gain (lbs) and BCS change		**+ 0.1**	**-1.3**
2nd Period (85 days)	Put into bale grazing	61	1600.2	6.4
	Taken out of bale grazing	61	1645.9	6.3
	BW gain (lbs) and BCS change		**+ 0.5**	**- 0.1**
3rd Period (70 days)	Put into bale grazing	59	1536.2	6.5
	Taken out of bale grazing	59	1570.7	6.7
	BW gain (lbs) and BCS change		**+0.5**	**+0.2**

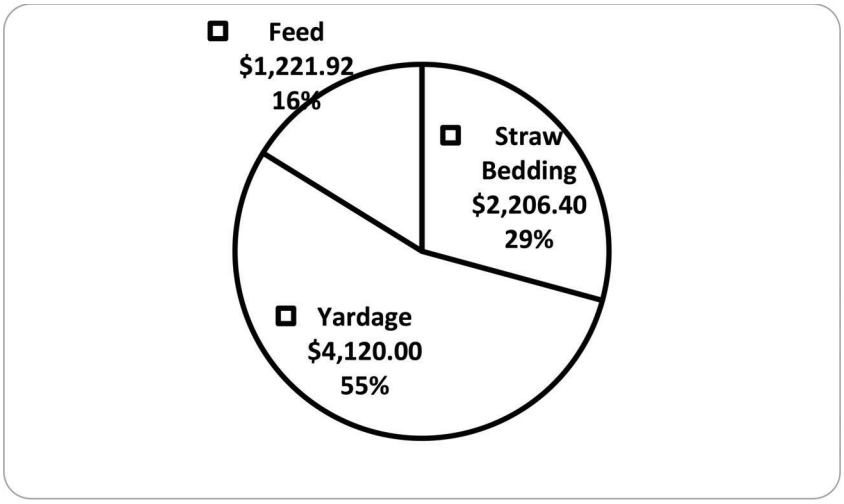

Figure 2: Expenses avoided per beef farm per year by extending the grazing season

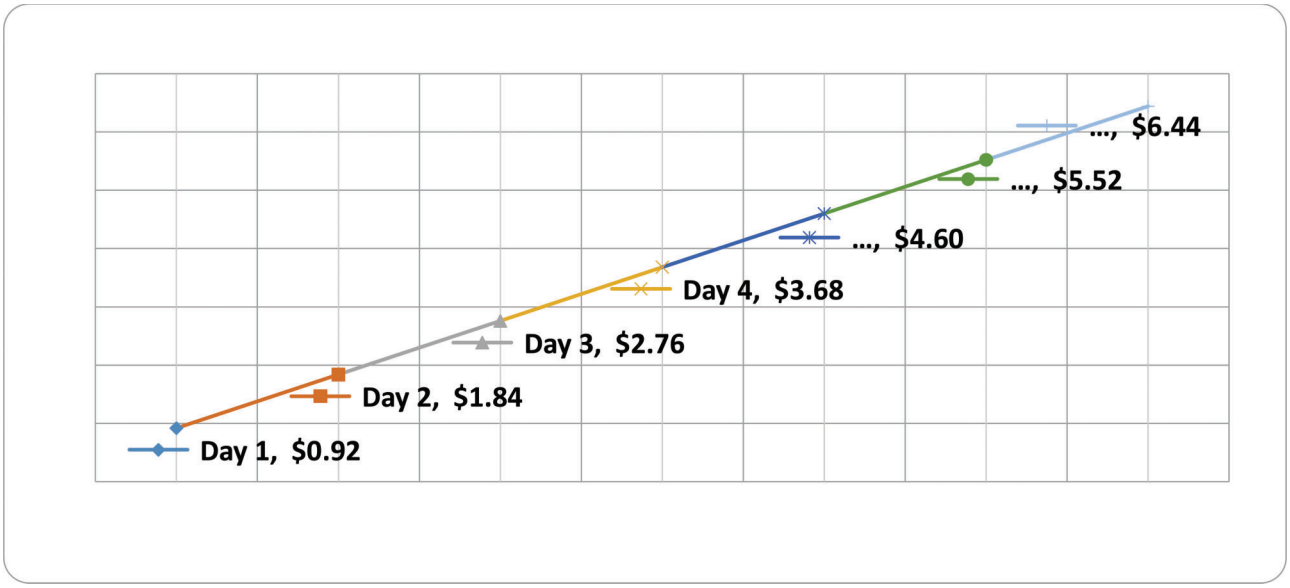

Figure 3: Expenses avoided per cow/calf days of winter grazing

additional costs including feed, building depreciation and repairs, machinery, fuel, labour and manure removal. The model shows that feed and yardage costs can be reduced by $1,221.92 and $4,120 respectively. This means a total cost of $7548.32 avoided, with a net cost saved of $7,331.92 per year, by taking into account the additional costs of $216.40 for windbreak, watering system and management training.

The period considered for the study is the overwintering period from November to mid-May (200 days), as the summer period is not taken into account. By considering the 200 days of overwintering period, the model indicates that extending the grazing season can lead to a saving of $0.92 per cow/calf per day. Thus as the number of cattle days on pasture increases, the greater the reduction in production costs (Figure 3).

Extending the grazing season is thus the most economically efficient feeding plan for Atlantic beef farmers. This result corroborates many results from western Canada showing the contribution of extending the grazing season to reducing winter production costs in beef production (Kaliel, 2004; Baron *et al.,* 2014; McCartney *et al.,* 2004). Atlantic beef farmers may thus improve the financial viability of their farm through the adoption of the extended grazing season feeding plan in their production system.

Extending the Grazing Season Does not Compromise Animals' Performance

Animals began bale grazing when they were in the middle of pregnancy. This makes it difficult to obtain a reliable body weight gain due to the interaction of the weight of maternal tissues with specific physiological stages such as pregnancy (Gionbelli *et al.,* 2015). In this situation, the body condition score, closely related to beef reproductive efficiency, is a more reliable indicator of the nutritional status of beef cattle (Rasby, Stalker and Funston, 2007).

The body condition score presents two advantages to help estimate the probability of re-breeding as well as calving condition. A high BCS may result in calving issues, mainly due to increased dystocia; while a low BCS

may compromise beef re-breeding capacity, mainly by increasing the post-partum interval. These situations could result in reduced income for the beef farmer. According to Parsons (2009), it is recommended that mature cows calve with a BCS of at least 5 and not more than 7. At NRF, it is generally expected that cattle will calve with a BCS between 5.5 and 6.5. The BCS at calving time of cows that bale grazed fall between 5.9 and 6.7 (Table 4) and thus are appropriate to allow for good reproductive performance. These results, along with the observations of beef specialists who conducted the study at NRF, reflect that animals at NRF have been able to maintain good performance on winter bale grazing.

Given the results of three bale grazing trials at NRF it is possible to say that, in the Atlantic region, beef cattle are able to maintain good performance in an extended grazing season feeding system. This result corroborates the results from western Canada showing that animals' performance on extended grazing season approaches were comparable to conventional feeding practices (Kelln *et al.,* 2011; Baron *et al.,* 2014). An extended grazing season feeding plan can thus procure an output comparable to the conventional feeding plan in Atlantic beef production.

6. Conclusions and Implications

The aim of the study was to determine, in comparison to the conventional feeding approach, the advantages and expected value of extending the grazing season in Atlantic beef production using stockpiled and baled forage. The purpose was to identify the most efficient feeding plan for Atlantic beef farmers using the partial budgeting approach.

The results show that, compared to the conventional feeding plan in Atlantic Canada, an extended grazing season approach is a more efficient feeding plan for Atlantic beef farmers. An extended grazing season feeding plan can reduce by 54% the total annual production cost for feed, yardage and straw bedding, compared to the conventional feeding plan. Indeed, extending the grazing season can contribute to avoiding expenses of $7,331.92 per farm per year through eliminating and/or reducing overwintering costs for feed (16% reduction), yardage (55% reduction) and straw bedding (29% reduction). A detailed analysis shows a saving of $0.92 in overwintering production costs per cow/calf per day. Therefore, as the number of cattle days on pasture increases, the greater the reduction in production costs will be. Furthermore, the results of animals' performance on winter bale grazing in Atlantic Canada show that the animals' weight and body condition score are at desirable levels.

The extended grazing season feeding plan could be an alternative solution to enhance beef farm financial viability in Atlantic Canada. In addition, it can also contribute to the sustainable development of beef farms through services provided by grassland systems such as carbon sequestration, recreation functions and environmental protection. These results reflect the need for forage and beef cattle production specialists to support and promote the adoption of extending the grazing season techniques for beef production in Atlantic Canada. This support could involve awareness, training on grazing management skills, workshops and participatory research.

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