The Value of Saskatchewan's Forage Industry

A Multi-Level Analysis

Sask Forage Council

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EXECUTIVE SUMMARY

This report presents an overview of the forage industry in Saskatchewan and the value that it generates both for the economy and the environment. The forage industry in Canada is not homogeneous; rather it can be described as comprising a number of sectors based on the end use of the forage crop. The diverse, extensive nature of forage production makes it difficult to assess and quantify both direct economic effects and indirect effects derived from this resource. This information is necessary to identify and illustrate the importance of forages in this province as well as to guide research, management and policy direction.

In November 2006, during the annual meeting of the Saskatchewan Advisory Council on Forage Crops (SACFC), discussion was initiated regarding the challenges within the sector including the need to increase dialogue between stakeholders and raise the profile of forages within the overall agri-food industry. This project was developed as a collaborative effort with input from many industry partners and in response to the directive from the SACFC.

This report looks at both the direct and indirect value created by forages in Saskatchewan. In this report, direct value of forages is captured as output quantity x output price. Indirect value is more difficult to define, but for the purpose of this report, forages are deemed to generate indirect value as they aid in the protection of natural resources and as they increase the ecological integrity of the landscape in Saskatchewan.

In 2006, Saskatchewan farms reported 5.2 million acres (2.1 million hectares) in tame hay, 4.8 million acres (2 million hectares) in tame pasture, 12.8 million acres (5.2 million hectares) of native rangeland and nearly 200,000 acres (80,937 hectares) of forage seed for a total of 23 million acres (9.3 million hectares) of forage land (Statistics Canada, 2006). By comparison, no other agricultural crop approaches the vast area that forage crops are grown on.

Through extensive research and stakeholder consultation, this report has quantified that forages are an important resource in Saskatchewan both in economic and environmental terms. As determined in this report:

- Direct economic value generated by forages is in the range of $740.4 million annually, generated through economic activity associated with a wide variety of sectors.

- In addition, there is potential in a number of sectors to grow and create direct value for forages. For example, there is potentially $11.2 - $137 million of direct economic activity to be generated from forage land depending on the future direction of climate change policy.

- Indirect benefits include ecological goods and services such as erosion control, flood control, water quality, wildlife habitat, pollination services and carbon sequestration. This report determined that forages provide an indirect value of $894.5 million - $1.9 billion annually in Saskatchewan.

- Savings from government programs due to current forage acres were estimated at $401.6 million per year.

- This report estimates that the total direct and indirect value from forages equals $2 - $3 billion annually in Saskatchewan.

The report also identifies issues and opportunities facing the advancement of the forage industry in Saskatchewan. A number of hurdles including reduced research and development funding, lack of a producer funded levy, transportation logistics and costs for the export industry, a depressed livestock industry, segmentation between forage sectors and a general lack of prominence as a crop in the agricultural matrix were discovered as challenges facing the industry. However a number of opportunities were identified as well. Strengthening links with the livestock industry, growth in organic livestock and crop production, carbon sequestration, agri-tourism, biofuels, new forage export markets and forage seed production were all identified as areas of potential for the forage industry to capitalize on.

Engagement of stakeholders and expansion of both public and private investment in the forage industry will be necessary to sustain and increase the value generated from forages in Saskatchewan.

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1.0 INTRODUCTION

Forages Defined

Definitions for the term 'forage' are as numerous as the sectors and stakeholders which comprise this far-reaching and expansive industry. Valentine (1990) defines forage as "that part of vegetation that is available and acceptable for animal consumption, whether considered for grazing or mechanical harvest; includes herbaceous plants in mostly whole plant form, and browse". For the purpose of this report, the Valentine definition will be used such that forages will be considered to include both perennial and annual vegetation suitable for livestock use.

Forages are produced across all agricultural regions of Canada. In 2006, 19.6 million acres (7.9 million hectares) of tame hay, approximately 14 million acres (5.6 million hectares) of tame pasture and another 38.2 million acres (15.4 million hectares) of native pasture were reported across Canada. In total almost 44% of Canada's total farm area is allocated to growing forage crops (Statistics Canada).

While Saskatchewan is often thought of for its production of grains and oilseeds, the province is in fact a major producer of forages with approximately 36% of total farm area dedicated to forage production. In 2006 Saskatchewan farms reported 5.2 million acres (2.1 million hectares) in tame forage, 4.8 million acres (2 million hectares) in tame pasture, 12.8 million acres (5.2 million hectares) of native rangeland and nearly 200,000 acres (80,937 hectares) of forage seed (Table 1.1 - Statistics Canada, 2006). By comparison, no other agricultural crop approaches the vast area that forage crops are grown on. For example, in 2006 in Saskatchewan, all wheat (spring, winter, durum, etc.) only accounted for approximately 20% of total farm acres. However, the diverse and extensive nature of forage production makes it difficult to assess and quantify both direct economic effects and indirect benefits derived from this resource. The impact forages have on the Saskatchewan economy, other agricultural sectors, the environment and society as a whole has to date not been quantified. This information is necessary to identify and illustrate the importance of forages in this province as well as to guide research, management and policy direction.

In addition to the acres reported through the Agriculture Census, First Nations land in Saskatchewan represents a considerable forage resource encompassing approximately 1.5 million acres of reserve land south of the Boreal region (unpublished data - First Nations Agricultural Council of Saskatchewan). Land use on reserves is not well documented, therefore it is unclear how much of this land is in forages, but anecdotal evidence suggests that approximately 60-65% of reserve land south of the Boreal region in Saskatchewan consists of native grass or pastureland (personal communication, Keith LePoudre).

Table 1.1 Forage Acreage in Saskatchewan

Forage Type	Acres	Hectares
Native Range	12,789,656	5,175,789
Tame/Seeded Pasture	4,848,756	1,962,222
Forage Seed	194,555	78,734
Alfalfa and Alfalfa mix Hay, Silage and Dehy	3,934,427	1,592,206
All other Hay, Silage and Fodder	1,217,674	492,775
Corn Silage	16,583	6,711
Subtotal - hay, silage, fodder	*5,168,684*	*2,091,692*
Total	**23,001,651**	**9,308,437**

Source: Statistics Canada, 2006 Census of Agriculture

The forage industry in Canada is not homogeneous; rather it can be described as comprising a number of sectors based on the end use of the forage crop. Many of the same forage species and varieties are used as amenity or turf species, for soil conservation, seed production for domestic and export uses, forage production for dehydration or other

processing and for grazing or stored feed for livestock.

In November 2008, Saskatchewan forage industry stakeholders came together to discuss the heterogeneous nature of the forage industry and were challenged to define the scope of forages in this province. The result of this consultation included a map of the forage industry, defining the value points created by forages, both in economic and environmental terms (Figure 1.1). This 'visual definition' of the forage industry in Saskatchewan was used as the basis for developing this report.

> "Feed for livestock accounts for approximately 80% of total forage production in Canada."

As illustrated in Figure 1.1, the primary use for forages is feed for livestock. In fact, feed for livestock including cattle, sheep and horses, accounts for approximately 80% of the total forage production in Canada (Agriculture and Agri-Food Canada, 2001). Forages include both annual and perennial crops. Annual crops such as cereals, peas and corn are usually harvested as silage, greenfeed or swath grazing while perennial crops of grasses and legumes are sown alone, or with a companion annual crop and are grazed or harvested annually for several years. Perennial forages are grazed as pasture, harvested as greenfeed, stored as hay or silage, or processed into pellets, cubes or compressed hay for domestic and export markets. Native rangelands represent a significant grazing resource in both Canada and Saskatchewan as pasture utilized by the livestock industry. As well, many annual crop by-products such as straw and chaff are utilized as a forage source for the livestock sector.

Limiting Factors to Calculating Value of Forages

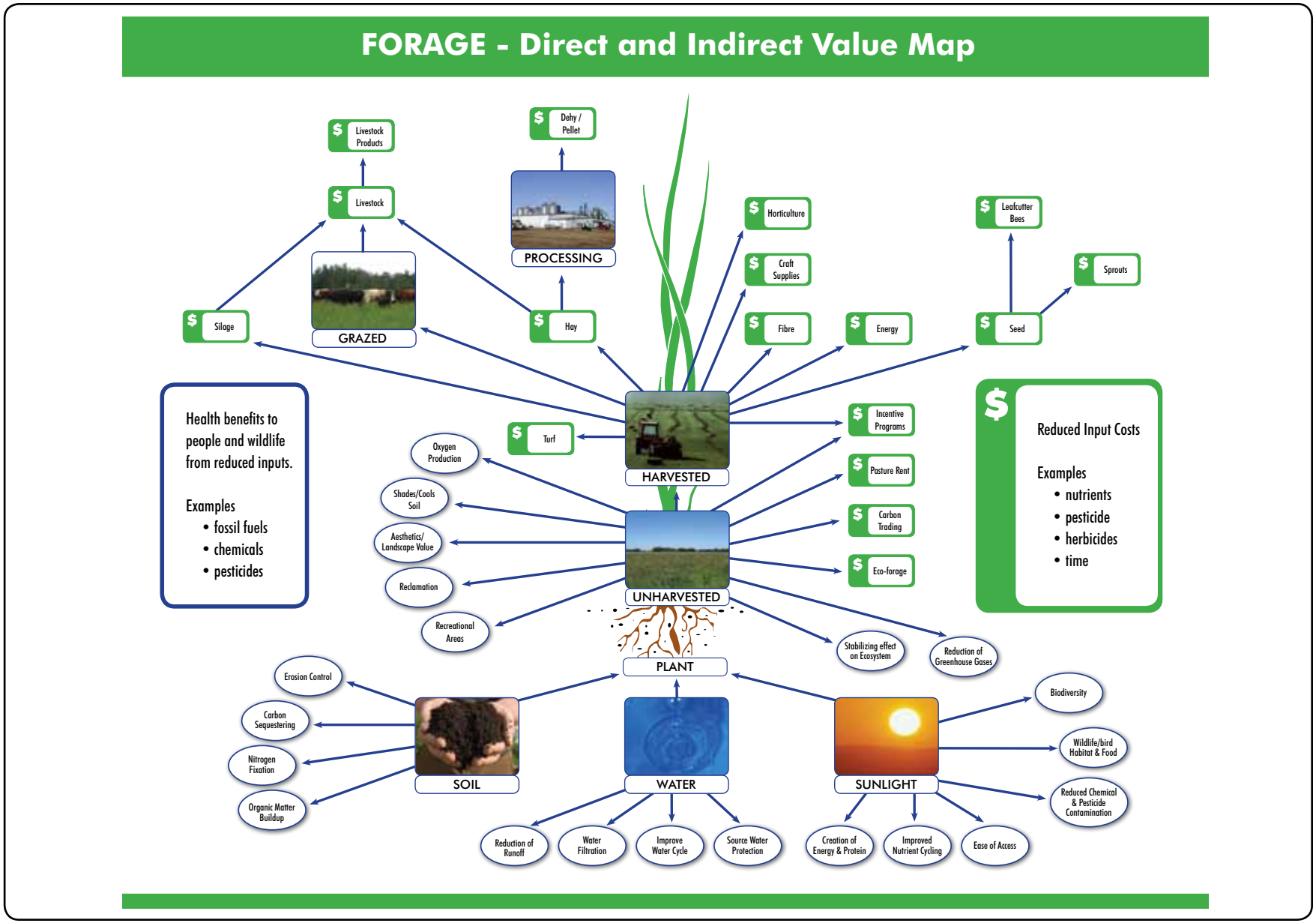
Stakeholder consultation was an integral part of developing and researching this report. Please refer to Appendix A for the list of agencies, organizations and individuals consulted in the process. During the stakeholder consultation phase of this project, segmentation of the industry was identified as one of the key reasons that the industry struggles to receive the awareness and recognition that it deserves as one of the major crops grown in the province. For the purpose of this report, value will be looked at first for each sector and then applied to the forage industry as a whole.

Forages lack a central marketing agency at both the provincial and national level. There is no single entity which tracks production and economic information for this commodity. Coupled with the segmentation in the industry is a general lack of information pertaining to forage production and value across Canada. Several provinces have provincial forage councils, such as the Saskatchewan Forage Council, or other forage organizations with similar mandates of advancing the interests of forage producers within their borders, but often these organizations are inconsistently funded and have small operating budgets that restrict the impact they are able to achieve.

There is indication from a number of industry stakeholders that a national group to represent the interests of the forage industry should be supported. The Canadian Forage and Grassland Association (CFGA) is a new association that is still in its development phase. The CFGA has recently applied for incorporation and is now working on a board structure (as of February 2010). The developers of the CFGA anticipate that the association will represent all aspects of the forage and grassland industry. However, one of the first hurdles this association will face is establishing a consistent source of funding and resources to carry out their objectives.

There is no check off (levy) associated with forage marketing in Saskatchewan (with the exception of forage seed). Many of the major agricultural commodities have provincial or national levies in place to fund research, technology transfer, policy development and market development. Due to the informal method by which much of the forage

Figure 1.1- Forage Industry Value



crop is marketed, the forage industry does not fit into the regulatory framework required for levy creation. The result is that unlike many other crops, the forage sector is unable to generate a pool of funding for research and development. For this reason forage research has traditionally been left to the public domain. Funding of forage research has been studied and has shown a drastic reduction over the past decade (Canadian Cattlemen's Association, 2008). Forage producers and users are beginning to recognize the challenges created by this lack of development and are searching for long-term solutions. Difficulty in securing research funding represents only one of the hurdles currently facing the forage industry.

Project Scope and Impact

This report provides an assessment of the current state of the forage industry, focusing on the market and non-market effects in the Saskatchewan economy and environment. A secondary objective of the report is to identify gaps and needs for development within the industry. Stakeholder consultation was an important part of this study to ensure that all sectors and the widest range of users were consulted regarding forage value and opportunities. With this approach, a concise measure of the forage industry and its positive impacts was developed and stakeholders were brought together to identify links that could potentially be made within the industry. By quantifying the environmental and social benefits of agriculture, there is now a measure of the phrase "stewards of the land", enabling producers to attach both value and meaning to that stewardship. This will assist producers and the agriculture and food industry as a whole raise awareness regarding their impact, as well as increasing the potential to create and seize new opportunities.

It is hoped that the impact of this empirical industry assessment will result in continued and enhanced dialogue and identification of opportunities for partnerships between sectors and increased awareness and visibility for the entire forage industry. As well, this assessment will provide positive input to policymakers for increasing the returns from investments in forages and altering investment patterns in forages at a provincial and national level. Environmental program planning, including land conversion programs, land set aside programs, riparian management programs, stewardship, and education will be more effective with input from this study. Having a clear understanding of the nature and extent of the forage industry's effects can also steer environmental policy regarding such aspects as carbon sequestration and management, endangered species protection, and environmentally responsible use of agricultural inputs (chemicals/fertilizers), thus enabling producers to assess more accurately the costs and benefits of their operations. Business risk management policy and value chain development in the forage industry will also be strengthened by using information from this study.

Finally, identifying the economic effects related to forage production will demonstrate where investments in value-added processing might occur, and where research and investment can provide the greatest returns.

2.0 BACKGROUND

For the purpose of this report, only the value generated from primary products will be included in determining the direct economic value of the forage industry. However, it is important to note that the forage industry creates a wide variety of spin-offs into a number of other industries as well as creating secondary effects (referred to as multipliers) through spending and re-spending of dollars stimulated by the forage industry. Some of these secondary effects include equipment sales, input sales, marketing services, processing facilities, manufacturing, as well as the associated labour and employment with these activities.

The livestock industry, including beef and dairy cattle, sheep, horses, bison, elk, deer and other specialized ruminant livestock, is the primary user of forage products in Canada. Ruminant livestock are unique in their ability to turn low quality fibre into high quality protein in the form of meat and milk. The success of ruminant agriculture is largely dependent on a stable supply of forages both in the form of pasture and stored feed. Statistics Canada estimated 2.65 million head of cattle and 82,000 sheep on farms in Saskatchewan as of January 1, 2009 (Table 2.1). Based on farm cash receipts from cattle and calves, the beef industry represented a $1.1 billion industry in Saskatchewan during 2008. Similarly in 2008, sales of dairy products totalled $157 million and lamb sales at $7 million. Without a thriving forage industry in this province, these livestock sectors would be severely impaired and would very likely become unsustainable.

Table 2.1 Cattle and Sheep on Farms as of January 1 in Saskatchewan (2000-2009)

Year	As of January 1	
	Cattle on Farms (million)	Sheep on Farms (thousands)
2000	2.25	91
2001	2.30	110
2002	2.42	117
2003	2.54	115
2004	2.86	125
2005	3.04	130
2006	2.95	105
2007	2.93	95
2008	2.87	88
2009	2.65	82

Source: Statistics Canada

It is also worth noting that the number of horses on farms reported by Statistics Canada underestimates the actual number of horses in the province as many are now considered companion, sport or competition animals and thus are not agricultural in nature (Table 2.2). The Saskatchewan Horse Federation estimates that the 2009 equine population is closer to 115,000 (Executive Director, Saskatchewan Horse Federation, personal communication).

Besides uses within the livestock industry, forage and forage products have a number of novel uses including, roadway/right of way cover, reclamation, soil conservation and conditioning, golf courses and turf, energy, fibre, horticulture, sprouts, honey production, as well as cover for parks and recreation areas. Urban development is a primary consumer for the sod sector as well as utilizing both tame and native species of forages in green spaces and common areas. Golf course development in Saskatchewan has also become an important consumer for the forage industry. These novel uses will be included as part of the analysis of direct value from forages where primary value is created (i.e. the sod and forage seed industry and the ecological goods and services from forage covered areas).

> "The success of ruminant agriculture is largely dependent on a stable supply of forages both in the form of pasture and stored feed."

Table 2.2 Livestock Numbers on Farms in Saskatchewan

Class of Animal	2001	2006
Horses	71,306	65,914
Bison	34,781	57,395
Goats	15,797	11,793
Mules	1,153	1,443
Elk	32,118	25,608
Deer	6,165	8,581
Alpacas/Llamas	3,744	4,474

Source: Statistics Canada

2.1 Definition of Value - Direct and Indirect

Direct Value

Due to the integration into other agricultural streams and sectors, the dollar value generated by forages in this province is poorly defined. To determine "direct" value created by forages, this report focuses on areas where cash value is created through primary production and sale of forage products. This will include products such as hay, forage seed, alfalfa for pellet and cube production and pasture production used for grazing.

The Merriam-Webster dictionary provides eight variations for the definition of 'value'. For the purpose of this report, direct value will be taken to represent the value of production captured by output quantity and output prices. The forage products investigated in this report and their direct values are listed in Table 3.15.

Indirect Value

The indirect value of forages on the landscape is more difficult to evaluate. The most common values listed in the literature are related to reduced erosion and sedimentation, enhanced biodiversity, increased carbon sequestration, improved water quality, mediation of flooding, wildlife habitat and recreation (hunting and fishing). This report evaluates the non-market value generated by forages as they aid in the protection of natural resources and increase the ecological integrity of the agricultural landscape in Saskatchewan. Activities which include indirect use of forage and their values have been summarized in Table 4.6.

3.0 DIRECT FORAGE VALUE CHAINS

3.1 Forage Seed Production

As of 2006, the forage seed industry in Saskatchewan comprised more than 194,000 acres. Table 3.1 reports the Census of Agriculture 2001 and 2006 number of farms growing forage seed and the number of acres harvested for forage seed production. Reported acres include both tame and native forages grown for seed. In 2006, Saskatchewan accounted for approximately 29% of the forage seed acres in Canada.

Table 3.1 Forage Seed Harvested as Seed

	2001		2006	
	Number of Farms Reporting	Acres	Number of Farms Reporting	Acres
Saskatchewan	1,015	166,771	775	194,555
Canada	3,808	799,415	3,069	661,923
SK % of Canadian total	27%	21%	25%	29%

Source: Statistics Canada, Census of Agriculture 2006.

Canadian Industry

Alfalfa is used throughout the world as a source of high protein roughage for livestock in pasture and hay. The Prairie provinces in Canada are well adapted to alfalfa seed production thus seed is produced almost entirely in Alberta, Saskatchewan and Manitoba. Canada has become a major exporter of alfalfa seed with exports originating primarily from the three Prairie provinces.

Alfalfa seed acreage increased during the 1990's for both pedigreed and common seed. Acreage of proprietary (private alfalfa) varieties also increased. During this time, alfalfa seed acre expansion occurred primarily in Manitoba and Saskatchewan. The trend toward increased use of private alfalfa seed varieties by both farmers and consumers is expected to continue (Alberta Agriculture and Rural Development, 2004). More recently, alfalfa seed acreage has declined on the Prairies mostly due to the lower potential returns from this crop relative to the returns from other annual crops.

Saskatchewan Industry

In Saskatchewan, the forage seed industry is represented by two main organizations: the Saskatchewan Alfalfa Seed Producers Association (SASPA) and the Saskatchewan Forage Seed Development Commission (SFSDC). SASPA is a non-profit corporation established by alfalfa seed producers in 1972 to support alfalfa seed and alfalfa leafcutter bee production in Saskatchewan. SASPA works on research and extension initiatives in the areas of alfalfa seed production and alfalfa leafcutter bee management and is actively engaged in the promotion of alfalfa as a forage crop throughout North America.

Alfalfa seed production accounts for the majority of forage seed production in Saskatchewan. In 1997, a development commission was established and began collecting levies on alfalfa seed ($0.0075/lb), enhancing the ability to fund research and development of alfalfa seed production and alfalfa leafcutter bee management. The Saskatchewan Alfalfa Seed Producers Development Commission (SASPDC) has tracked acres and production and reports that over the last decade, acres of alfalfa seed production have remained relatively steady. SASPDC annual reports state that Saskatchewan has accounted for 70-75% of the alfalfa seed acreage in Canada since 2000. Table 3.2 reports

"In 2006, Saskatchewan accounted for approximately 29% of the forage seed acres in Canada."

Table 3.2 Alfalfa Seed Levy and Alfalfa Seed Production in Saskatchewan

Year	Total Annual Levy Collected	Approximate Production (lbs)	Approximate Annual Value of Production* (Millions)
2000	$90,731	12,097,467	$12.1
2001	$111,140	14,818,667	$14.8
2002	$216,407	28,854,267	$28.8
2003	$169,508	22,601,067	$22.6
2004	$169,019	22,535,867	$22.5
2005	$51,215	6,828,666	$6.8
2006	$89,143	11,885,733	$11.9
2007	$201,033	26,804,400	$26.8
2008	$104,527	13,936,933	$13.9
Average	**$133,636**	**17,818,119**	**$17.8**

**Based on average price of $1.00/lb for alfalfa seed*
Source: Saskatchewan Alfalfa Seed Producers Development Commission Annual Reports, 2000-2008

Table 3.3 Forage Seed Levy and Value of Forage Seed Production in Saskatchewan

Year	Total Annual Levy Collected	Total Value of Annual Production*
2006	$40, 950	$5.5 million
2007	$63,867	$8.5 million
2008	$58,215	$7.8 million
Average	**$54,344**	**$7.3 million**

**Based on levy collection*
Source: Saskatchewan Forage Seed Development Commission Annual Reports, 2006-2008

levies collected by the SASPDC as well as the approximate annual production and value of alfalfa seed. As shown in Table 3.2, alfalfa seed production has generated an average of $17.8 million dollars annually in Saskatchewan. Approximately $21.5 million in production is expected for 2009 (SASPDC Executive Director, personal communication).

The Saskatchewan Forage Seed Development Commission (SFSDC) was established in July of 2005. The purpose of the SFSDC is to perform research and development for the benefit of the forage seed industry, through collection of a refundable levy (0.75% of gross value). SFSDC collects levies on all forage seed crops, excluding alfalfa (see Appendix C for a list of forage seeds included in this levy). Since its inception in 2005, the SFSDC has collected levies on forage seed from registered producers in the province. Table 3.3 shows the value of forage seed levies collected by SFSDC and the value of forage seed production during the years since the commission began collecting levies.

The SFSDC annual reports for 2006 and 2007 report eight active buyers/processors of Saskatchewan forage seed. Red clover was the highest value crop and had the most registered producers in both 2006 and 2007. Annual and perennial ryegrasses were the second highest value crops grown in Saskatchewan during 2006. Based on levies collected by SFSDC, the average value of forage seed production in Saskatchewan is $7.3 million per year (Table 3.3).

Since formation of the SFSDC, the number of registered forage seed growers in Saskatchewan has dropped dramatically. In 2006 there were approximately 400 registered seed growers in the province, declining to approximately 200 in 2009. This trend has also been noted in Manitoba and Alberta. This decline in the number of growers is attributed to a number of factors including the decrease in forage seed returns and the relatively greater returns from other annual crops (SFSDC Executive Director, personal communication). However, this trend may reverse if annual crop prices decrease, or if demand for forage seed increases.

Native seed production in Saskatchewan is a smaller portion of the forage seed industry, however interest in planting native species appears to have grown in the past number of years. According to a study of the native plant market in Saskatchewan in 1997, there were 17 producers of native plant material with the majority of producers offering a small amount of limited species. The Native Plant Society of Saskatchewan (NPSS) updated the list of native plant suppliers in 2009 and found that the number of suppliers had dropped to 14 (NPSS Executive Director, personal communication). This decline has largely been due to producers retiring and no younger generation replacing them.

Uses for native plant species generally fall under three main categories:
- reclamation;
- forage for grazing; and
- landscaping.

According to the NPSS, interest in using native legumes and grasses as a source of forage for livestock has been increasing. The main obstacles to wider use of native species appear to be price and availability of seed. The NPSS feels that an increase in the number of growers and suppliers of native seed in Saskatchewan would ensure a more consistent and economical supply of seed. Currently buyers looking for large quantities of native seed often are directed to Alberta suppliers.

Due to the extensive nature of the native seed industry, production and economic information is very limited. The study conducted in 1997 attempted to collect information on the production of various species, but due to limited response and the fact that some of the major players declined to participate, the information was deemed unrepresentative and therefore was not reported. A review of the native seed industry has not been conducted since 1997. Note that some native forage species - those thought to be the most commonly grown in the province - are subject to check off through the SFSDC (Appendix C). Therefore value for the majority of native seed sales are captured by the SFSDC levies reported in Table 3.3.

3.2 Alfalfa Leafcutter Bees

The production of alfalfa seed and alfalfa leafcutter bees are very closely linked. Alfalfa seed growers depend on leafcutter bees to pollinate alfalfa and ensure optimal seed set. Due to the importance of bees to seed production, the Saskatchewan Alfalfa Seed Producers Development Commission recognizes alfalfa leafcutter bee parasite and disease control as one of its research priorities. The development of specialized management practices in Canada has made this country a leading producer of alfalfa leafcutter bees.

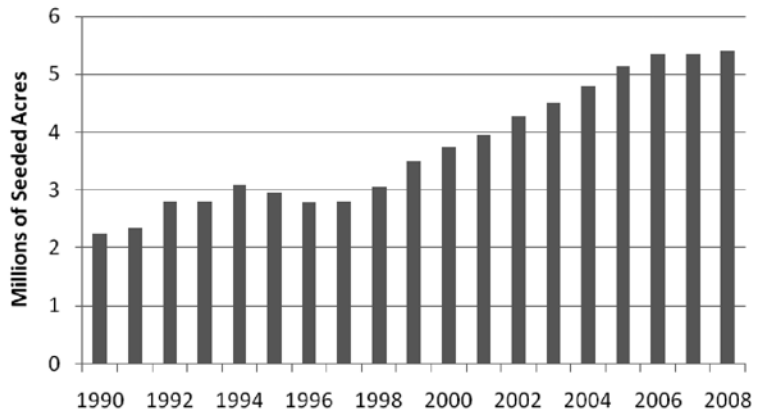
> " Approximately 2 billion alfalfa leaf cutter bees are required to maintain the acres of alfalfa seed production in Saskatchewan."

Most alfalfa seed producers market surplus bees thus generating a secondary source of income. Approximately 2 billion alfalfa leafcutter bees are required to maintain the acreage of alfalfa seed production in Saskatchewan (20,000 bees/acre). Based on the reproductive capability of these bees, populations can double every year with surplus bees exported primarily to the US. According to SASPDC annual reports, export sales of alfalfa leafcutter bees generate approximately $10 - 15 million per year (SASPDC Annual Reports, 2000-2008).

3.3 Hay (Domestic)

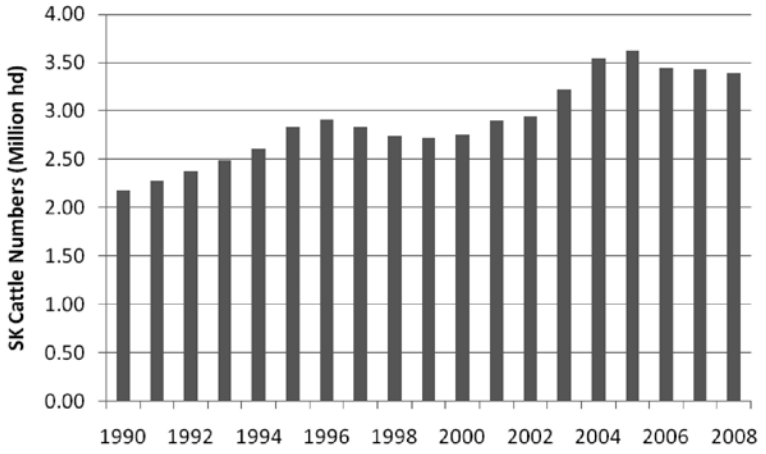
Area seeded to tame hay in Saskatchewan is tracked yearly by Statistics Canada through their seeding intentions and harvest surveys as well as through the Census of Agriculture. Although some fields are used for both hay and pasture, farmers are asked to report area in tame hay and area in tame pasture separately to avoid duplication in reporting. In 2006, 26.2% of Canadian alfalfa and other tame hay area was located in Saskatchewan. Over the period from 1990-2008, seeded acres of forages for hay in Saskatchewan have more than doubled from

Figure 3.1 Seeded Acres of Forages for Hay in Saskatchewan, 1990-2008



Source: Statistics Canada

Figure 3.2 Cattle Numbers in Saskatchewan 1990-2008



Source: Statistics Canada

approximately 2.3 million acres to 5.4 million acres (Figure 3.1).

The increase in forage acres is largely tied to the increase in cattle numbers during this same period as the cattle industry is the major consumer of hay in Saskatchewan. Figure 3.2 shows the trend in cattle numbers in Saskatchewan during the same 1990-2008 period.

The Saskatchewan Ministry of Agriculture summarizes estimates of hay production annually, however sales are not closely monitored by any entity in Canada. In Saskatchewan, the Ministry of Agriculture has traditionally published an estimate of hay production and hay value based on estimated hay yields from regional crop reporters and pricing information from the Saskatchewan Forage, Feed and Custom Service Listing. Seeded acreage numbers are based on Statistics Canada numbers, whereas harvested acres and production estimates are based on information from Saskatchewan crop reporters located around the province. Table 3.4 summarizes the historic production and pricing for tame hay acres in Saskatchewan for the period 2000-2008.

"Hay production in Saskatchewan creates an average value of $292.4 million annually."

Yearly average price has been determined by a weighted average of hay price listings from the Saskatchewan Ministry of Agriculture's Forage, Feed and Custom Service Listing (price data not collected by the Ministry after 2004). This listing represents a limited sample of hay prices from across the province. The very limited historical information on hay prices clearly speaks to a significant need within the forage industry.

Recently, the Saskatchewan Forage Council (SFC) has partnered with Saskatchewan Crop Insurance Corporation (SCIC) to conduct a bi-annual survey of the forage market in the province. This survey began in 2007 and has grown to include a contact list of nearly 100 sources located around

the province to determine forage pricing. The Forage Market Price Survey published twice a year by the SFC is currently the most comprehensive source of information on hay prices available in Saskatchewan.

Table 3.4 Tame Hay Acres, Production and Pricing (2000-2008)

Year	Seeded acres	Harvested Acres	Yield T/acre	Production T	Farm Price* $/T	Value $
2000	3,750,000	3,530,000	1.09	3,764,800	66	248,476,800
2001	3,950,000	3,050,000	0.73	2,131,900	86	183,343,400
2002	4,275,000	3,300,000	0.64	2,086,500	124	258,726,000
2003	4,500,000	4,075,000	0.73	2,903,000	89	258,367,000
2004	4,800,000	4,375,000	1.09	4,944,200	72	355,982,400
2005	5,150,000	4,450,000	1.27	5,806,000	-	-
2006	5,346,700	4,300,000	1.27	5,488,500	45*	246,982,500
2007	5,350,000	4,410,000	1.27	5,511,100	65.5*	360,977,050
2008	5,400,000	4,655,000	1.00	4,490,600	95*	426,607,000
Average	4,724,633	4,016,111	1.01	4,125,178	87	**292,432,769**

Source: Saskatchewan Ministry of Agriculture, Agriculture Statistics Database
**Indicates average price- Saskatchewan Forage Council Forage Market Price Reports*

Table 3.5 Forage Price for Tame Hay in Saskatchewan as Determined by Forage Market Price Survey

Year	Month	Price ($/T)
2007	January	40
2007	July	50
2008	January	64
2008	July	67
2009	January	90
2009	July	100

Source: Saskatchewan Forage Council Forage Market Price Surveys (2007-2009).

Table 3.5 shows average pricing information from the SFC price surveys conducted for the period 2007-2009. The prices presented are for baled hay averaged across type (grass, legume, or mixture) as well as quality. In general, the January and July surveys in the same year represent prices for the previous crop year of hay. For example, the pricing information reported in the January and July survey from 2007 represents average pricing for the 2006 hay crop. This is due to the fact that when the July survey is conducted, there is limited new crop on offer as producers are busy harvesting at that time. The July survey does however, begin to identify trends for demand and supply in the current harvest year.

Pricing information from both the Saskatchewan Forage Council Survey and the Ministry of Agriculture were compiled to provide an examination of the period from 2000 - 2008. Table 3.4 shows the annual average value of hay production in Saskatchewan is estimated at approximately $292 million based on production and pricing information for the nine year period beginning in 2000.

Other reports examining domestic hay value and pricing have also grappled with how most accurately to assign value to hay, a commodity that is primarily produced for on farm use, with a limited amount sold off-farm. Information from Agriculture and Agri-Food Canada's Market and Industry Services Branch estimates that approximately 80% of Canadian hay does not enter any formal marketing channel (Agriculture and Agri-Food Canada, 2001). Based on that reality, a recent report looking at the value of forages in Ontario claims that applying market prices to all hay will likely overstate the value of this commodity (Fisher,

2008). This study included a survey of Ontario producers and found that applying a market price to all hay overestimated the value of production by approximately 13%.

Applying this information, the value of hay in Saskatchewan could be adjusted down by 13% to reflect the value of hay in inventory and off-farm sales of this commodity. Taking into account the downward adjustment, the average value of hay produced in Saskatchewan between 2000 and 2008 would be estimated at $254 million per year. However, based on the current pricing information available for Saskatchewan, hay value will be considered at the full market price of $292.4 million per year. This value more accurately reflects the replacement cost for hay in the market.

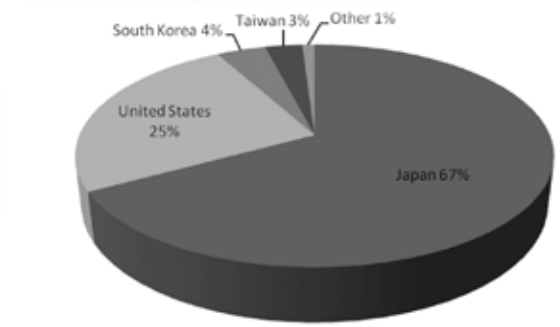
3.4 Forage Export Products

Canada's reputation as a premier supplier of forages has continued to grow since an export market was first developed for this commodity. Canada is the third largest exporter of forage products and has approximately 10% of the world market share (Manitoba Forage Council, 2009). Major markets for Canadian forage products include the US, Japan, Korea, and Taiwan along with several other countries on a smaller spot market basis. Processed alfalfa products have been exported since the mid 1970s, compressed hay since the mid 1980s, and baled hay for many decades.

Figure 3.3 shows the major client countries for forage exports in 2007. Japan and the US accounted for over 90% of Canadian forage exports, indicating the dependence of the Canadian export industry on these two countries at present. Japan and the US have been Canada's major trading partners for forages over the last decade.

Exports of forage products are considered in this report due to the fact that exports of this commodity represent value creation from the primary product. Forage products exported from Saskatchewan include forage seed, processed alfalfa (pellets, meal and cubes), compressed hay and uncompressed hay. Processed alfalfa and compressed hay exports will be discussed in the next section, while exports of forage seed and other hay exports will be covered in this section. Exports are tracked by Canada Border Services and are captured in a database maintained by Industry Canada through the Trade Data Online database.

Figure 3.3 Exports of Canadian Forage Products in 2007



Source: Statistics Canada

Table 3.6 reports the dollar value of forage seed exported from Saskatchewan to all other countries between 2000 and 2008. On average, Canada exports $19.3 million of forage seed annually. The US is the major market for both alfalfa and other forage seeds.

Exports of all non-timothy hay are presented in Table 3.7. These values were determined by examining the value of all hay exports and removing export timothy values (export timothy will be discussed in the following section).

This data shows an average of $3.5 million of hay exports (excluding timothy) annually from Saskatchewan. Discussions with industry specialists and stakeholders have revealed that export volumes, especially for non-compressed (i.e. other than timothy) hay, are very

Table 3.6 Value of Forage Seed Exported from Saskatchewan (in Millions $)

Year	Forage Seed		Total
	Alfalfa	Other	
2000	4.9	9.6	14.5
2001	9.4	11.0	20.4
2002	16.5	7.1	23.6
2003	10.2	6.2	16.4
2004	13.5	5.7	19.2
2005	4.9	7.9	12.8
2006	11.9	9.2	21.1
2007	13.1	10.6	23.7
2008	13.5	8.3	21.8
Average	**10.5**	**8.6**	**19.3**

Source: Statistics Canada

Table 3.7 Value of Non-Timothy Hay Exported from Canada and Saskatchewan

	2003	2004	2005	2006	2007
	Value in Millions $				
Canada	11.4	12	12	13	n/a
Saskatchewan	5.7	3.7	2.2	5	1

Source: Statistics Canada, World Trade Atlas.

likely underestimated due to gaps in data collection. For example, a load weight is not recorded if the claimed commercial value is below a United States Department of Agriculture (USDA) specified threshold for hay imported from Canada into the US. This could represent a significant amount of hay especially for self transported truckloads of forage taken into the US. Also, it is not always clear that hay exported from Saskatchewan is recorded as such if it travels through other provinces en route to a port. These suggestions should be considered when looking at the value of forage exports from Saskatchewan.

3.5 Processed Forage Industry

In Canada, the processed forage industry consists of two main sectors, alfalfa dehydration ('dehy') and hay compaction. Processed products include dehydrated alfalfa meal and pellets, sun-cured alfalfa pellets, alfalfa cubes and compressed bales of timothy, alfalfa, mixed hay and straw. The processed forage industry is highly export dependant with approximately 70-75% of processed alfalfa being exported and essentially all compressed forages being exported (Saskatchewan Forage Processors, personal communication). The forage industry's processing activities are concentrated in the Canadian Prairies, with some facilities also located in Ontario, Quebec and New Brunswick. Saskatchewan is currently home to three alfalfa processors and one hay compaction facility. Saskatchewan's alfalfa processing industry began in the early 1970s as an opportunity for farmers, mainly located in the northeast region of the province, to grow alfalfa forage, process it into pellets and sell it into an established market in Japan.

Tables 3.8 and 3.9 show the value and tonnage of processed alfalfa (alfalfa meal, pellets and cubes, including both dehy and sun-cured) exported from various provinces in Canada and indicates that Saskatchewan is a major contributor to Canada's alfalfa export industry.

The Saskatchewan industry currently processes in excess of 100,000 tonnes annually from a land base of approximately 50,000 acres. Most of the processing takes place in northeast Saskatchewan; with alfalfa cubes also processed in the Outlook irrigation district. This industry has generated between $20-30 million/ year for the Saskatchewan economy over the period from 2003-2007. In 2007, Canada exported $35.7 million in alfalfa

"The Saskatchewan industry currently processes in excess of 100,000 tonnes of alfalfa annually from a land base of approximately 50,000 acres."

Table 3.8 Value of Processed Alfalfa Exported from Canada by Province (in Millions $)

	2003	2004	2005	2006	2007	Average
Canada	46	58	53	49	53	51.8
Saskatchewan	19	19	26	23	30	23.4
Alberta	16	28	21	20	18	20.6
Ontario	8	6	4	4	4	5.2
Quebec	1	1	1	1	1	1

Source: Statistics Canada, World Trade Atlas.
Prepared by: Statistics and Data Development Unit, Alberta Agriculture and Rural Development.

Table 3.9 Processed Alfalfa Exported from Canada by Province (tonnes)

	2003	2004	2005	2006	2007
Canada	185,614	302,059	241,629	220,104	235,792
Saskatchewan	74,815	89,363	131,294	109,781	141,751
Alberta	69,800	127,309	91,152	88,339	75,862
Ontario	25,917	20,717	14,270	14,712	13,859
Quebec	2,319	2,693	2,454	5,402	2,489
Manitoba	838	624	888	638	1,003
British Columbia	11,925	61,352	1,571	1,232	828

Source: Statistics Canada, World Trade Atlas.
Prepared by: Statistics and Data Development Unit, Alberta Agriculture and Rural Development.

meal and pellets, as well as $17.2 million in alfalfa cubes, $30 million of which came from Saskatchewan (Statistics Canada). It is worth noting that the Canadian pelleting/cubing industry once exported over 700,000 tonnes/year to the Asian market during its peak (1998) whereas now average yearly exports are around 250,000 tonnes. Although this industry has undergone contraction over the past number of years, it still represents a significant contribution to the provincial economy.

Unlike exports of this product, sales of processed alfalfa within the province are not tracked in detail. However, in consulting with the dehy industry in Saskatchewan, it is estimated that approximately 30% of processed alfalfa is sold in the province and 70% is exported. Based on those estimations, in the time period from 2003-2007 when exports of processed alfalfa averaged $23.4 million, domestic sales of processed alfalfa could be assessed at $10 million/year.

Canada's compressed (or double-compressed) hay industry, first established in the mid-1980s, uses hydraulic pressure to compress field hay bales into bales less than half their original size. Worldwide, the term "compressed hay" refers to various forage products compressed into tightly bound, high density, low moisture bales. Compressed products marketed around the world include grass-seed straw aftermath, alfalfa hay, sudangrass/bermudagrass from the US and oats green-feed from Australia. However, in Canada, the term "compressed hay" is almost exclusively timothy hay with some alfalfa or alfalfa grass mix hay.

Timothy forage is largely sold into Japan and other Pacific Rim countries as a long fibre component in the diets of dairy and beef cattle. Timothy is also used in the horse industry in the US and Asian markets.

The first trial shipment of compressed hay was shipped from Canada in 1981 and consisted of 17 tonnes (Agriculture and Agri-Food Canada, 2001). The market expanded rapidly in the late 1990s and in 2007-2008 exported 300,000 tonnes. A value for all compressed forage was not available; Table 3.10 reports the value and tonnage of timothy hay (shipped almost exclusively as compressed) exported from Canada by Prairie province.

Canadian exports of timothy hay nearly doubled from 1998 to 2005 and remain at 300,000 - 400,000 tonnes/year level. Currently, Japan

Table 3.10 Timothy Hay Exported from Canada by Province

	2003	2004	2005	2006	2007
			tonnes		
Canada	212,902	323,814	317,180	386,366	421,080
Alberta	186,626	287,453	284,753	343,756	373,469
Saskatchewan	7,656	14,458	9,598	11,332	9,833
Manitoba	10,469	11,931	12,046	18,521	15,568
			Value (in Millions $)		
Canada	74	98	93	105	123
Alberta	65	88	84	94	111
Saskatchewan	3	4	3	3	3
Manitoba	3	3	3	5	4

Source: Statistics Canada, World Trade Atlas.
Prepared by: Statistics and Data Development Unit, Alberta Agriculture and Food.

is the major market for compressed timothy hay. Between 2003 and 2007, Saskatchewan timothy exports have averaged $3 million annually (Table 3.10). Saskatchewan is a small player in the compressed hay industry due to the lack of processing facilities in the province. This is illustrated by the fact that over the same time period (2003-2007), Canadian timothy exports have averaged over $100 million dollars annually.

A number of market forces and logistical factors with shipping this product from Western Canada overseas have resulted in a concentration of the compressed hay industry, with the majority of plants located in Alberta. In 2006 there were eight plants operating in Alberta, three in Saskatchewan, three in Manitoba, and one in the Maritimes. Presently there is one plant operating in Manitoba and one plant in Saskatchewan with 12 plants in Alberta (Alberta Agriculture and Rural Development, 2009).

Closure of compressed hay processing plants in Saskatchewan was mostly attributed to the difficulties in transporting this product to the customer. The logistics of obtaining rail containers and shipping containers, as well as the cost of ocean freight became limiting factors, especially for smaller operations. The remaining plant in Saskatchewan is transitioning away from the export timothy market in favour of the pet food market. The Saskatchewan plant currently supplies all of their own timothy without purchasing off farm. The Canadian compressed hay industry has noted that overall demand for timothy is declining. Japan is the major buyer of this product and due to the excess production of milk in Japan, demand for timothy in dairy diets is dropping. Also Japan has increased imports of alternative, cheaper sources of fibre in recent years, particularly oat hay from Australia. This has had a negative impact on the compressed timothy hay industry in Canada.

However, there appear to be opportunities for compressed hay (timothy, alfalfa and alfalfa grass mix) from Canada to move into new markets (Glenn Friesen - Manitoba Agriculture, Food and Rural Initiatives, personal communication). Recent policy changes in some Middle Eastern countries (Saudi Arabia and United Arab Emirates) have limited or will soon limit their ability to supply hay into their domestic livestock sector. Over the next decade, it is estimated that the Middle East market could represent a 20-25% growth for the Canadian hay export market. Because of Canada's ability to produce high quality hay, it is important that Canada positions itself to take full advantage of this emerging market. There also exists potential to supply China and Mexico with compressed hay.

3.6 Pasture/Grazing

Pasture acres in Saskatchewan sustain several ruminant livestock industries including beef, dairy, sheep, goats, bison, and specialty livestock such as elk and deer. Companion animals such as horses also represent a significant user of pasture acres. Saskatchewan farms reported approximately 4.8 million acres of tame pasture and 12.8 million acres of native pasture in 2006 (Statistics Canada). Besides privately owned or leased acres, Agriculture and Agri-Food Canada - Agri-Environment Services Branch (AESB - formerly PFRA) manages 2.3 million acres across the Prairie provinces within the Community Pasture Program, 1.8 million acres of which are located in Saskatchewan.

These 17 million plus acres of pasture represent a vast resource that contributes significantly to the agricultural economy in the province. While many livestock producers own the land their stock grazes, custom grazing rates or pasture rental rates from both privately owned land and crown land/provincial land can be used to estimate the economic value of pasture acres.

"These 17 million plus acres of pasture represent a vast resource that contributes $254.3 million annually to the Saskatchewan economy."

As part of the 2009 Saskatchewan Forage Council Forage Market Price Survey, grazing rates around the province were included and will continue to be part of the survey going forward. In this survey, the Saskatchewan Ministry of Agriculture, Agriculture and Agri-Food Canada - Agri-Environment Services Branch, the Saskatchewan Watershed Authority, Ducks Unlimited Canada, as well as several private land owners were contacted regarding grazing rates for 2009.

Rates for grazing land owned or managed by government agencies (provincial and federal pastures) ranged from $0.25-0.40/cow/day. Normally in these pastures, the owner of the cattle is provided with fence, water, and animal management. Government agencies reported that in addition to the per day charge, there is also a calf fee of $18-22/calf/grazing season, a breeding or bull fee, mineral fee, and a land tax fee. Any treatment or animal health product costs incurred are charged to the owner of the cattle as well. Once all of these yearly fees are accounted for, the cost is approximately $0.40-0.55/cow-calf pair/day ($14/AUM) over an average five month grazing season.

Pasture listings on private land were also explored in July 2009; however, a limited amount of information on private land grazing rates was discovered during this survey. This is likely due to the nature of the business with most agreements made on a private basis. In the 2009 survey, grazing rates for private land ranged from $0.40-1.10/pair/day. The rates range widely partially due to the difference in services included by the landlord on private land as well as differences in regions of the province. Some rates include animal management, while others do not. An average of $0.75/pair/day ($22.50/AUM) could be considered reasonable for situations where a landowner is renting out fenced pastureland and the livestock owner is responsible for animal management. This price ($22.50/AUM) represents the value of forage with no other services included.

Data was sourced from Saskatchewan Assessment Management Agency (SAMA) to give an indication of the breakdown of pasture acres by soil zones in Saskatchewan. SAMA is an independent agency that provides reliable, up-to-date property assessment valuations to the provincial government for their various programs relating to land use. For more information on how this data was combined with Statistics Canada data, and the data from SAMA, please refer to Appendix B.

Using the recommended stocking rates for native and tame pasture in the various soil zones of Saskatchewan, productive capability can

Table 3.11 Value of Pasture for Grazing in Saskatchewan by Soil Zone

	Soil Zone				
	Brown	**Dark Brown**	**Black**	**Gray/Gray Wooded**	**Total Value ($)**
Total Native acres [a]			12,789,656		
%of acres [b]	43	19	17	21	
Native acres	5,499,552	2,430,034	2,174,241	2,685,828	
Average AUM/acre [c]	0.30	0.39	0.54	0.35	
Total Native AUM's	1,649,866	947,713	1,174,090	940,040	
AUM value($)	22.5	22.5	22.5	22.5	
Native Pasture value ($)	37,121,985	21,323,543	26,417,025	21,150,900	**106,013,450**
Total Tame acres [a]			4,848,756		
%of acres [b]	32	22	23	23	
Tame acres	1,551,602	1,066,726	1,115,214	1,115,214	
Average AUM/acre [d]	0.89	1.52	1.61	1.61	
Total Tame AUM's	1,380,926	1,621,424	1,795,495	1,795,495	
AUM value ($)	22.5	22.5	22.5	22.5	
Tame Pasture value ($)	31,070,830	36,482,029	40,398,627	40,398,627	**148,350,110**
Total Pasture Value ($)	68,192,815	57,805,572	66,815,652	61,549,527	**254,363,560**

[a] *Based on Statistics Canada (Agriculture Census 2006)*
[b] *Based on SAMA data (2009)*
[c] *Based on Stocking Rate Guide from Abouguendia, 1990 (average across all range sites in good condition) x 1.5 to reflect actual grazing practice.*
[d] *Based on Saskatchewan Ministry of Agriculture Initial Stocking Rate Recommendations for Seeded Pasture, 2008 (stand age of 4-6 years, with no fertilizer, averaged between soil types in good condition) x 1.5 to reflect actual grazing practice.*

be extrapolated. However, from discussion and observation of actual grazing practice around the province, stocking rates are often higher than recommended rates. Through this consultation, 1.5 times the recommended stocking rate was determined to be more reflective of actual practice. A survey of the Community Pasture Program showed that the majority of pasture land was in good condition (Agriculture and Agri-Food Canada, 2007). For this reason, the stocking rate for pasture in good condition was chosen for use in this report. By applying a value for AUMs, the value of pasture in Saskatchewan can be estimated.

This calculation arrives at a total value for pasture land in Saskatchewan of $254.3 million (Table 3.11). It is also worth noting that there is a significant amount of grazing on annual crop aftermath (residue following harvest of annual crops) which is increasingly becoming part of a livestock operation's forage budget, however is not accounted for in these calculations. A value for residue grazing is not available as there is no reporting method for this activity.

3.7 Silage and Greenfeed

Silage refers to forage harvested while still green and then fermented anaerobically to preserve the quality of the feed. In Saskatchewan, silage is made from both perennial and annual forages and is an important source of livestock feed, especially in the beef and dairy industry. In Saskatchewan the major annual crop used for silage is barley, but others such as corn, triticale, sorghum or sudangrass are also used. In addition to crops that are seeded with the intention of making silage, some damaged annual crops may be salvaged as silage each year. In Saskatchewan, alfalfa and other perennial forages are made into silage to a lesser extent than barley.

Greenfeed refers to annual forage harvested prior to grain maturity and

baled as livestock feed. There are other methods where annual crops may be harvested and conserved as livestock feed such as yellowfeed and swath grazing. Annual crops used as forage include a wide variety of cereal grains, legumes and oilseeds. Damaged (due to weather events such as drought or hail) annual crops may also be salvaged as a forage source each year.

"The combined value of silage for dairy and feedlot use is estimated at $31.1 million per year."

It is difficult to quantify the amount of silage and annual crops grown as forage in this province. In the most recent Agriculture Census (2006) conducted by Statistics Canada, farmers were asked to report annual crop acres grown for grain only with the exception of corn. Saskatchewan corn silage acres totalled 16,583 acres in 2006. Other annual crop silage (i.e. other than corn silage) and "fodder" acres are included in the "other tame hay" category on this census questionnaire. Similarly, alfalfa silage is incorporated into the "alfalfa and alfalfa mixtures hay" category, thus determining silage acres from the census data is not possible.

Silage acres can be estimated based on livestock use. For example, there are 30,000 dairy cows in Saskatchewan that are each fed approximately 5 tonnes of forage dry matter per year. If half of this total is fed as silage (mostly barley, some corn and alfalfa silage), then 2.5 tonnes x 30,000 cows = 75,000 tonnes of silage dry matter or 225,000 tonnes of wet silage. Assuming a dry land silage yield for Saskatchewan barley silage of 6 tonnes/acre (2 tonnes/acre of DM), acres required to produce this silage would then be 225,000 tonnes/6 tonnes/acre = 37,500 acres. Additionally, silage is fed to dairy replacement heifers increasing the requirement by approximately 10% (247,500 tonnes). Also, if most silage is stored in bunkers the amount required must be scaled up by 15-20% to allow for storage and handling losses (297,000 tonnes). This results in approximately 49,500 acres of silage grown in Saskatchewan for dairy cattle (University of Saskatchewan Dairy Specialist, personal communication).

Likewise, production of silage for feedlots can be used to extrapolate silage acres in Saskatchewan. In 2008, it is estimated that 400,000 head of cattle were backgrounded and 160,000 head of cattle were finished in feedlots in Saskatchewan (Saskatchewan Ministry of Agriculture, Feedlot Consultant, personal communication). A backgrounded calf will consume approximately 1.17 tonnes of silage whereas a calf only consumes approximately 0.3 tonnes during the finishing period (Irrigation Crop Diversification Centre, 2005). This results in a requirement of (400,000 hd x 1.17 tonnes/hd) + (160,000 hd x 0.3 tonnes/hd) = 516,000 tonnes of silage. Again assuming that most feedlots store silage in bunkers, the amount required must be scaled up by 15-20% to allow for storage and handling losses (raises requirement to 593,400 tonnes). Using the average barley silage yield of 6 tonnes/acre, acres required to produce this silage is 593,400 tonnes/6 tonnes/acre = 98,900 acres.

The combined value of silage for dairy and feedlots can then be calculated as follows:
297,000 tonnes for dairy cattle + 593,400 tonnes for feedlots = 890,400 tonnes at an average price of $35/tonne (University of Saskatchewan Dairy Specialist, personal communication) = $31.1 million from 148,400 acres of silage.

The value of green feed in the province is not able to be estimated as there is no clear data for this feed type. Needless to say, it must be recognized as an important and valued forage source for livestock in Saskatchewan.

3.8 Turf/Sod

Turfgrass or sod is produced in an intensively managed agricultural operation. It is removed intact with a minimal amount of soil, transported and transplanted in another area to form an intact turf cover. Most sod

operations are within 50 miles of their consumers due the harvested product's vulnerability to heat and dehydration. This limitation coupled with transportation costs confines the location of these operations to areas surrounding more densely populated areas. Of total sod sales, approximately 60% are for residential construction and 40% for various commercial uses such as schools, factories, sport fields and highways. Over the years, the use of sod on sports fields and golf courses has increased but has decreased on highways. The demand for sod is largely dependent on the housing market. With an increase in urban populations and housing comes an increase in the demand for sod (Ontario Ministry of Agriculture Food and Rural Affairs, 2003).

Total sod area in Canada increased by 1.8% to 58,962 acres (23,862 hectares) between 2006 and 2007. This rise followed a growth of 10.0% recorded between 2005 and 2006. The Prairie provinces gained 10.2%, while Québec saw a decrease of almost 8.0%. Total sod sales in Canada increased by 1.1% to $128 million ($2171/acre) in 2007 (Statistics Canada).

There were 888 acres of sod reported by 13 farms in Saskatchewan (Census of Agriculture, 2006) which is an increase of 26% since 2001 when there were 702 acres reported by nine farms. Based on these numbers, the 2006 acreage in Saskatchewan produced sales of approximately $1.9 million ($2171/acre x 888 acres).

3.9 Sprouts

There is one major producer of forage seed sprouts in Saskatchewan, located in north central Saskatchewan. According to this producer, just over 50% of sales are domestic with the remainder exported mostly to the US. This producer acts as a supplier of both small retail packages and large commercial truckload shipments based on the retail needs of their customer. In consultation with this organic producer, he estimates sales of $500,000 in 2008 for forage sprouts of which alfalfa is the primary sprouting seed with limited quantities of red clover seeds. Sales of forage seeds for sprouting are a major contributor to the producer's business at 50% of total sales. This producer entered the sprouting business in 1982 and has grown this side of his business to where it is now the sole focus of the operation. When speaking to this producer, he remarked that demand for all types of sprouts has jumped significantly in the past year (personal communication).

3.10 Straw

Livestock use accounts for a significant portion of straw and crop residue, both in the form of feed and bedding. Sokhansanj et al (2006) conducted a research study looking at the availability of straw for industrial use in which livestock demand for straw as feed and bedding was calculated. Based on average winter feeding and bedding periods in the north, central and southern parts of Alberta and Saskatchewan, they calculated that straw demand in Saskatchewan (based on livestock numbers from 1994-2003) was 1.813 million tonnes per year with 1.08 million tonnes required for feeding alone.

The Saskatchewan Forage Council has included straw pricing in their bi-annual Forage Market Price Report for the past number of years (2006-2009). Table 3.12 provides the reported values of straw from these surveys.

Table 3.12 Straw Values in Saskatchewan

Year	Price ($/tonne)
2006 crop	25.00
2007 crop	32.91
2008 crop	37.50
Average	**31.80**

Source: Saskatchewan Forage Council Forage Market Price Reports

Using an average price ($31.80/tonne), livestock demand for straw as feed represents a value of $34.3 million/year ($31.80/tonne x 1.08 million tonnes) in Saskatchewan. This value is likely underestimated

as the straw availability in this study focused on cereal straw and flax only. Pulse straw and oilseed straw are also used as livestock feed and would add value to this market.

Straw for feed was the only straw use included in this valuation as straw for feed is considered part of a forage budget. Straw can be considered an alternative to hay or other forages, so was included in this report. Likewise industrial uses for straw will not be included in this valuation as they do not represent a value to the forage industry.

3.11 Carbon Credits and Carbon Trading

The Government of Canada has indicated that they are dedicated to working on reducing greenhouse gas (GHG) emissions in Canada. Government and non-government organizations are looking at various initiatives to achieve the reduction of GHGs both on the end of emission reductions and increased carbon capture. One of the main ways that agriculture can contribute to the reduction of GHGs is management of soils as a carbon capture sink.

Due to the regulations surrounding GHG emissions both in Canada and abroad, markets for carbon trading have emerged over the past decade (for example, the Montreal Climate Exchange or MCeX and the Chicago Climate Exchange or CCX). Markets for emissions trading have the potential to benefit both greenhouse gas emitters, by lowering the cost of reducing emissions and for farmers, who can increase their farm income by adopting Best Management Practices (BMPs) that reduce emissions and enhance storage of GHGs. In the past few years, carbon trading has grown significantly with emissions trading on the CCX nearly tripling from $10.9 billion in 2005 to $30.1 billion in 2006 (King, 2008). Although it is not possible to determine what portion of this economic activity is linked to agricultural involvement, the potential for growth in this area appears to be significant. However, caution must be exercised as the current uncertainty surrounding GHG policy has caused carbon trading activity to decrease and until policies are set, this trend will likely continue. For example, the average value for carbon on the CCX during 2008 was approximately $3.73/tonne while during 2009 the value dropped significantly to approximately $0.95/tonne.

> "The largest potential for carbon credits related to forage land is likely the conversion of annual cropland to permanent cover."

Agriculture systems can make contributions to lowering GHG concentrations in the atmosphere in two ways: reduce emissions from fossil fuels, fertilizers, and livestock, and/or enhance storage of GHGs from the atmosphere with biological sinks. Currently, carbon trading with respect to forage acres specifically is still quite limited. This is mostly due to the lack of protocols quantifying the impact on carbon balances of land management practices involving grazing and forage management.

In Saskatchewan, legislation regarding carbon credit and carbon offsets is currently under development. In May of 2009, Saskatchewan introduced the *Management and Reduction of Greenhouse Gases Act* to the legislature which states a provincial goal of a 20% reduction below 2006 levels (2006 level was 71.2 million tonnes of $C0_2e$) in greenhouse gases emissions by 2020. This Act was reintroduced with minor changes on December 1, 2009 and to date (February, 2010) the Act has received first reading, and is awaiting second reading and debate. Public consultation regarding draft regulations will take place in March and April of 2010 and Saskatchewan Environment officials anticipate regulations will take effect in summer 2010 (personal communication).

Currently, the primary vehicle for gaining carbon credits for Saskatchewan producers is through commercial aggregators. These organizations "pool" carbon credits from individual producers that can then be offered to emitters as offsets. In Alberta, the provincial government is involved in issuing carbon credits and has established a set of

protocols to allow producers to participate in carbon trading. Alberta officials state that there are currently no forage related protocols due to the complexity in establishing standards for these protocols. However, Alberta is working on protocols for rangeland, conversion of annual cropland to perennial cover and grazing management.

Nationally, the Government of Canada announced (June 2009) an offset program where producers who can demonstrate a verifiable reduction in CO_2 can receive credits on registered projects. While there are no forage related projects on the list right now, the program is likely to be expanded over time (Environment Canada, 2008). Also, the Government of Canada has indicated that they will attempt to harmonize this federal program with current and proposed provincial ones. Once these federal and provincial programs are finalized, it is likely that the carbon trading market in Canada will increase. In the United States, the Senate is currently debating (as of February 2010) the *American Clean Energy and Security Act* recently passed in the House that attempts to create a cap-and-trade scheme for carbon emissions in the US similar to that used in Europe. If this Act is passed it would certainly mean a surge in carbon credit trading. The Director of Green Products at CME Group reports that the voluntary market in the US has grown to the point where approximately $118 billion worth of carbon credit contracts were traded in the US during 2008 and the market is expected to reach $150 billion in 2009 (Wall Street & Technology, 2009).

Under the Alberta program, carbon offsets purchased through agricultural related protocols in 2008 ranged in value between $9-14/tonne CO_2e. These carbon "offsets" were sold to companies that require reduced emission credits in exchange for a producer following a protocol which shows a reduction of carbon emissions or increased carbon sequestration on their farm. The protocol generally represents a change in management practice for the farmer to demonstrate a net removal of carbon from the atmosphere.

Ongoing research related to carbon sequestration and carbon emissions from forage and grazing systems is beginning to provide some of the information needed to develop carbon markets for these lands. This research is necessary to verify and substantiate practices related to forage and grazing management to allow for the development of benchmarks within protocols. The largest potential for carbon credits related to forage land is likely to be the conversion of annual cropland to permanent cover. For example, if a producer in Saskatchewan converts marginal annual crop land to perennial cover, past research has shown that this change in cropping practice will represent a net measurable sequestration of carbon on an annual basis (Nelson et al, 2008 and Mensah et al, 2003).

Table 3.13 Environmentally Marginal Land under Annual Cultivation, 1997

	Soil Zone					
Province	**Black**	**Dark Brown**	**Brown**	**Dark Gray**	**Gray**	**Total***
			Hectares			
Manitoba	218,000	0	0	41,000	20,000	279,000
Saskatchewan	**319,000**	**897,000**	**615,000**	**105,000**	**79,000**	**2,016,000**
Alberta	185,000	293,000	234,000	93,000	135,000	939,000
Total	722,000	1,190,000	849,000	238,000	234,000	3,234,000
			Acres			
Manitoba	538,690	0	0	101,313	49,421	689,424
Saskatchewan	**788,266**	**2,216,535**	**1,519,698**	**259,461**	**195,213**	**4,981,644**
Alberta	457,145	724,019	578,227	229,808	333,592	2,320,320
Total	1,784,101	2,940,554	2,097,925	588,111	578,227	7,991,388

Source: PFRA, 2000.
• Numbers may not sum due to rounding

Table 3.14 Potential Carbon Trading Value from Conversion of Marginal Cropland in Saskatchewan

	Soil Zone		
	Brown/Dark Brown	**Black/Gray/Dark Gray**	**Total**
Area of marginal land (ha)	1,418,308	472,770	1,891,078
CO_2 Sequestration rate* (T/ha/yr)	5.85	3.3	
CO_2 Sequestered (T/yr)	8,297,102	1,560,141	9,857,243
Value of CO_2** ($/T)	$0.95	$0.95	$0.95
Potential Yearly Value ($)	**7,882,247**	**1,482,134**	**9,364,381**
Potential Yearly Value ($/ha)	5.56	3.14	4.95

**Median value from research conducted by Nelson et al, 2008 and Mensah et al, 2003 converted to CO_2 equivalents.*

***Based on average value for carbon on CCX for 2009 ($/T CO_2)*

Prairie Farm Rehabilitation Administration (PFRA) conducted a detailed study of marginal land that was under annual crop management considered to be unsustainable both environmentally and economically. This "marginal" land was comprised mainly of Canada Land Inventory (CLI) classes 4, 5 and 6. This survey took place following the permanent cover programs offered in the late 1980s and early 1990s that were aimed at converting marginal land to permanent cover. During these programs, 1.2 million acres (500,000 hectares) of marginal land were converted to more sustainable uses including forage and pasture (PFRA, 2000). However, Table 3.13 notes that there was still a significant area of marginal land under annual cultivation in the Prairie provinces, in particular in Saskatchewan, as of 1997.

Since 1996, there has been one major land conversion program. The Greencover Canada Program ran from 2003-2007 and was aimed at converting marginal land to permanent cover. Under this program 308,689 acres (124,922 hectares) of marginal annual cropland was converted to permanent cover in Saskatchewan (Greencover Canada Land Conversion Program, unpublished data). Using this data, the total area of marginal land in Saskatchewan under annual cultivation would be reduced to 1,891,078 hectares (4,672,956 acres).

Research conducted in Saskatchewan has suggested that conversion of annual cropland to perennial cover can result in carbon sequestration rates of between 0.6 - 1.2 Mg C/hectare/year (2.2 - 4.4 tonnes CO_2/hectare/year) on Gray and Black soils (Mensah et al, 2003) and between 0.3 - 2.9 Mg C/hectare/year (1.1 - 10.6 tonnes CO_2/hectare/year) on brown and dark brown soils (Nelson et al, 2008). Using these numbers, predictions can be made (Table 3.14).

Table 3.14 suggests that an average return of $4.95/hectare could be expected when converting marginal land to perennial cover with the potential to generate $9.3 million annually if all marginal land (as described above) were converted to perennial cover in Saskatchewan. This estimate is based on average values for soil carbon sequestration rates from soil carbon research conducted in Saskatchewan and using an average value for carbon from the CCX during 2009 ($0.95/tonne of CO_2). In 2008, carbon values were much stronger on the CCX at an average of $3.73/tonne of CO_2. At the 2008 Alberta rate for carbon (average $11.50/tonne), the average return jumps to $59.94/hectare with a potential to generate $113.4 million per year on the same land base.

Various studies have looked at the potential for reductions in GHG emissions from improved grazing management practices. In an assessment conducted for Alberta Agriculture and Rural Development, it was concluded that the overall potential to adopt practices that reduce GHG emissions on existing Alberta rangeland (native grasslands) was small (Bremer, 2009). This was due to the fact that most rangeland in Alberta was rated as healthy. For rangeland rated as unhealthy or healthy with problems, the potential for net reductions of C was greater, but still

represented a small potential. Other studies suggest that there may be potential from improved grazing management either through reduction in methane emissions from grazing animals due to increased forage quality (McCaughey et al, 1999; Chaves et al, 2006) or through increased soil carbon sequestration due to increased forage productivity (Conant and Paustain, 2002; Moulin et al, 2002). However, the lack of baseline data on soil C levels in various forages and the often short-term nature of these studies have not been sufficient to allow for development of definitive protocols. Currently, the Canada National Inventory for GHG assumes there is no potential for increasing soil C on grasslands from improved grazing management (Environment Canada, 2008).

Wetlands contained within forage land can also contribute to carbon sequestration, especially if drained wetlands are restored. Wetland restoration can help sequester carbon by creating very productive environments with anoxic conditions where decomposition is reduced and leads to the accumulation of organic matter in soils and sediments. Euliss et al. (2006) estimated that restored prairie pothole wetlands sequestered 11.2 Mg C/hectare/year and similarly research conducted through the Agriculture and Wetlands Greenhouse Initiative (AWGI) showed recently restored semi permanent wetlands in grasslands sequestering carbon at a rate of 11.8 Mg C/hectare/year. This research found that restored wetlands were a net carbon sink of 9.6 Mg C/hectare/year (Badiou, Ducks Unlimited Canada, unpublished data). The Saskatchewan North American Waterfowl Management Plan (NAWMP) Implementation Plan suggests restoring 56,000 wetland basins as part of the habitat restoration objectives to return waterfowl populations to 1970's levels. Assuming each restored wetland is equal to 1 hectare in size and is contained within forage land, the estimated amount of carbon dioxide sequestered by restored wetlands is approximately 10 Mg C/hectare/year x 3.67* x 56,000 hectares = 2,055,200 tonnes of CO_2 per year. This translates into a potential value of between $1.9 million/year (based on the average value during 2009 on the CCX) and $23.6 million annually (based on average value of C in 2008 Alberta program).

*conversion factor for C to CO_2e

3.12 Energy

Forages have the potential to produce an energy source in two major forms - cellulosic ethanol and fuel pellets. Pellets are used as a fuel for heat production while cellulosic ethanol is used as a petroleum fuel replacement. In Eastern Canada, switchgrass *(Panicum virgatum*) is the main crop of interest for the fuel pellet industry with big bluestem also being used to a lesser extent. Switchgrass is best suited for areas with 2200 corn heat units (CHU) or greater.

Figures 1 and 2 in Appendix D show the accumulated corn heat units in Saskatchewan. While the first map (Figure 1) shows that a number of areas in Saskatchewan can receive 2200 CHU in 50% of years, the second map (Figure 2) shows that the area more consistently receiving 2200 CHU (90% of years) is much smaller. This climatic limitation may impact the potential for this crop to be grown successfully in Saskatchewan. However, there may be opportunities for better adapted, cool season grasses. In 2009, field trials looking at biomass crops indicated that intermediate and tall wheatgrass showed potential as fuel crops in Saskatchewan (Bruce Coulman, unpublished data).

Currently in Saskatchewan there is no commercial scale production of forage fuel pellets. Commercial facilities are operating in Ontario and Quebec. There is potential in Saskatchewan to modify existing pelleting and alfalfa dehy facilities for this use, but this has not happened to date. Small scale demonstration projects have been undertaken in the past few years in the province looking at the agronomic suitability of various energy crops. At this time, most are focused on agronomics of these crops rather than the commercialization of the energy source.

> " Forages have the potential to produce an energy source in two major forms - cellulosic ethanol and fuel pellets."

The main markets emerging for grass pellets are commercial heating applications in North America and Europe. In particular, the North American greenhouse industry is a promising entry market, as profitability of this sector is greatly impacted by rising heating costs. As well, rural energy users are familiar with the use and handling of feed pellets for livestock farming operations. There are no significant technical barriers to overcome in the development of grass pellets for the bioheat industry, rather the main barrier to the emergence of this industry in North America is a lack of parity in biofuel incentives. There are currently no federal incentives either in the United States or Canada for the bioheat industry.

In contrast, a significant amount of research and investment has gone into development of the technology needed to digest cellulose-based feedstock to produce ethanol. Interest in cellulosic ethanol production has grown over the years driven by the 'food versus fuel' debate as the cellulose-based material cannot be used as a human food source, and due to the low cost of the initial feedstock. Cellulose ethanol can be produced from a wide variety of feedstock including wood waste, woody perennials (willow, hybrid poplar), annual crop residue (straw, stover), and grasses (switchgrass, grass clippings, sugarcane, sorghum).

One of the main hurdles to commercialization of this technology has been the development and production of enzymes required for cellulose breakdown. There are several demonstration plants currently operating within the US and Canada, but there are no commercial facilities at this time. In Saskatchewan, there are currently two proposed plants, (located in Hudson Bay and Prince Albert) by two different ethanol producing companies; KL Energy Corporation/ Prairie Green Renewable Energy and Iogen. The facility proposed in Hudson Bay has indicated that it will use wood waste as the main feedstock, while the proposed Prince Albert site has suggested they will rely on annual crop residue (mainly wheat straw). At this time (February, 2010) financing is not in place for either facility and construction has not begun.

A value for forage crops used as energy sources has not been estimated in this report. Until such time when commercial plants are operating in the province and creating demand for feedstock, the value of forages in this process will remain unknown.

3.13 Tourism and Parks

Based on estimates by the Government of Saskatchewan, tourism contributes approximately $1.5 billion annually to the provincial economy and is one of Saskatchewan's most rapidly growing industries. Nearly 57,000 Saskatchewan people are employed in tourism and tourism-related jobs (Saskatchewan Ministry of Tourism, Parks, Culture and Sport). Travellers to Saskatchewan often cite the draw of natural wonders and vast prairie landscapes as a reason to explore the province. Due to the strong connection between this landscape and tourism activities, this industry relies significantly on forages in the province.

More recently, agri-tourism has grown as an alternate way for farm operators to generate income. Agri-tourism can be defined as "travel that combines rural settings with products of agricultural operations - all within a tourism experience that is paid for by visitors" (Tourism Saskatchewan, 2008). Interest in this sector is growing and often activities associated with agri-tourism rely either directly or indirectly on forage land. The link between native grassland, or perennial grassland cover and nature viewing, aesthetic appeal as well as hiking and biking trails is becoming apparent. Advantages of agri-tourism include, increasing awareness of local agricultural products, creating greater appreciation of the importance of maintaining agricultural land uses, providing farm family members with on-site employment opportunities and strengthening the long term sustainability for farm businesses.

In a study to gauge interest in agri-tourism of Canadian and United States residents, 7.3 % of those surveyed had participated in more than one agri-tourism activity in the past year and were deemed to have high interest in agri-tourism (Travel Activity and Motivation Survey (TAMS), 2001). Also from this survey, 33% of travellers reported participating

in at least one agri- tourism activity while travelling in the last two years (TAMS, 2001). While all of the agri-tourism activities included in this survey do not directly involve forages (for example - visiting a farmers' market), the land base for many agri-tourism activities more directly rely on forages (guest ranches, working farms, wildlife and hiking tours, wildlife viewing, etc).

If 7.3% of the tourism revenue in Saskatchewan is attributed to agri-tourism (based on the TAMS survey), agri-tourism revenue can be estimated at $109.5 million annually. If one third of this revenue can be assumed to depend on forage land, this means that forage land in the province generates a value of $36.1 million/ year from agri-tourism. These assumptions are based on tourism surveys as there is no direct information gathered on agri-tourism activities in Saskatchewan. In using the TAMS survey, this estimate (36.1 million/ year) encompasses activities such as guest ranches and working ranches as the only activity that directly relates to forage land. Other activities such as hiking and biking trails, wildlife viewing, hunting, and travel to parks also rely largely on forage land bases. However, the assumptions used in this example assume that 7.3% of the total tourism revenue would not have occurred without the agri-tourism activities. This may not be the case as agri-tourism activities may be associated with other primary tourist activities and thus not all of the tourist value would disappear if agri-tourism activities did not take place.

> "The link between native grassland or perennial grassland cover and nature viewing, aesthetic appeal as well as hiking and biking trails is becoming apparent."

Consultation with the tourism industry has revealed there is a lack of statistics regarding agri-tourism in Saskatchewan. There is currently no formal tracking of agri-tourism ventures in Saskatchewan either by enumeration or reporting of economic activity. Listings on the Tourism Saskatchewan website include over 25 guest ranches, 50 locations for wildlife viewing and 48 tour operators with hiking and biking trails (Tourism Saskatchewan Website, accessed November 12, 2009). These tourism venues all rely on forage land as part of their property appeal. According to a study looking at agri-tourism in the Parkland region of Saskatchewan, many feel there is strong potential for growth in this area. A number of existing successful tourism and/or agri-tourism businesses are already located across Northern Agricultural Regions and tourism traffic through the regions on the way to northern destinations is strong and growing (Saskatchewan Ministry of Agriculture, 2008).

Saskatchewan is also home to 34 provincial parks and 162 regional parks located throughout the province covering 3.5 million acres. Different classifications under *The Parks Act, 1986* outline different purposes for these lands (conservation, recreation, cultural and natural preservation), but a common thread is that forages are the dominant cover in many parks. In 2004, statistics showed an average 2.1 million visitor days at provincial parks. In 2008, 3.1 million visitor days were recorded and the upward trend appears to be continuing (Saskatchewan Ministry of Tourism, Parks, Culture and Sport).

There are two national parks in Saskatchewan, one of which is entirely located within the Mixed Grass Prairie accounting for 122,317 acres of native grassland (Grasslands National Park). Grasslands National Park estimates 6000-7000 visitors/year over the five year period from 2003-2007. However, there is not an entry fee for Grasslands National Park, only camping and other usage fees are collected. The annual value of these fees was not attainable for this report.

Besides the revenue parks generate, they preserve important ecosystems, landscapes and cultural resources. Provincial park lands are material evidence of the cultural and natural environments that have existed within the province and, as such, are irreplaceable. Provincial

park lands make up 27% of the Saskatchewan Representative Areas Network (RAN) that is the cornerstone of the Government's Saskatchewan Biodiversity Action Plan (Saskatchewan Ministry of Tourism, Parks, Culture and Sport).

Based on the estimates of agri-tourism activities, forage land contributes $36.1 million/year to the Saskatchewan economy.

3.14 Total Direct Value Generated by Forages in Saskatchewan

This report has found that forages generate direct economic value in a variety of ways in Saskatchewan. Table 3.15 summarizes the total direct value of forages in Saskatchewan at approximately $747.4 million annually, with the potential to grow and create value in several sectors. For example, there appears to be potential to generate an additional $11.2- $137 million depending on the future of climate change policy and carbon offset trading in this province.

Pasture and hay generate the largest economic impact which reinforces the connection between the forage and livestock industries in this province. However, the forage seed sector, the processed forage industry and export forage products also contribute significant revenue to the larger forage industry in Saskatchewan. The role of forage land in agri-tourism is also a significant contributor to the provincial economy.

Table 3.15 Estimated Total Direct Value Generated by Forages in Saskatchewan

	Current Value (Millions $/year)	Potential Value (Millions $/year)
Forage Seed - alfalfa	17.8	
Forage Seed - other	7.3	
Leafcutter Bees	12.5	
Hay - domestic	292.4	
Processed Alfalfa - export	23.4	
Processed Alfalfa - domestic	10.0	
Compressed Timothy - export	3.0	
Forage Seed - export	19.3	
Other Hay - export	3.5	
Pasture	254.3	
Silage	31.1	
Straw - feed	34.3	
Sod	1.9	
Sprouts	0.5	
Carbon Trading - forage		9.3 - 113.4
Carbon Sequestration - wetlands		1.9 - 23.6
Agri-Tourism	36.1	
Total Market Value of Forage in Saskatchewan	**747.4**	**11.2 - 137.0**

4.0 INDIRECT FORAGE VALUE CHAINS

Besides the direct value chains described earlier in this report, forages create value through indirect means such as enhancing biodiversity, reducing erosion, improving water quality and many other ecological benefits sometimes referred to as ecological goods and services. Non-market values contribute significantly to the total estimated value of forage land in Canada.

In this section of the report, indirect or non-market value of forages will be based on published research values and in most cases be presented as a range rather than a specific value. Wherever possible, the focus will be on data and studies from Saskatchewan but may also include values from the Prairies or other areas in Canada. This report will not attempt to predict indirect values but rather will focus on applying published values to the current forage land situation in Saskatchewan (forage land area reported in Table 4.1).

Table 4.1 Forage Land Reported in Saskatchewan During 2006

Forage Type	Acres	Hectares
Native Range	12,789,656	5,175,789
Tame/Seeded Pasture	4,848,756	1,962,222
Forage Seed	194,555	78,734
Alfalfa and Alfalfa mix Hay, Silage and Dehy	3,934,427	1,592,206
All other Hay, Silage and Fodder	1,217,674	492,775
Corn Silage	16,583	6,711
Subtotal - hay, silage, fodder	*5,168,684*	*2,091,692*
Total	**23,001,651**	**9,308,437**

Source: Statistics Canada, 2006 Census of Agriculture

There are typically two methods of assigning non-market values to ecological goods and services. The first is measured through the cost of economic damages, reduced productivity, or lost income of not having the ecological good in place on the landscape. The second method looks at the willingness of individuals to pay for goods and services. There are few valuation studies that present a single number for a service. Due to the nature of this data, typically a range of values are presented. Despite the challenges in determining value estimates for ecological goods, it is important to include the value of these goods and services as they represent an important value to both the environment and the economy.

For example, protecting watersheds through proper riparian area management provides water filtration services that reduce the need for costly water filtration infrastructure. The cost of building and maintaining a human made system for water filtration can be estimated and a range of values provided. The classic example is the city of New York where they were faced with building a new water filtration system that was estimated to cost between US $6 to $8 billion and an additional $300 million annually to operate as compared to protecting the existing watershed at a cost of $1 to $1.5 billion. The city chose to protect the watershed by employing a number of best management practices (BMPs) to further increase the filtering capacity of the landscape. The non-market savings due to the BMP implementation was $5 to $7 billion (US Environmental Protection Agency, 2006).

4.1 Erosion Costs

Soil erosion continues to occur on the Prairies and Saskatchewan is particularly vulnerable due to the extent of annual crop acres on the landscape. Soil erosion can result from wind, water and landscape modification (tillage practices). Rates of erosion are highly variable across Saskatchewan depending on the soil type, slope, soil texture and cropping practice but several studies have tried to quantify rates of soil loss (Kiss et al., 1986, Pennock and de Jong, 1987, Pennock and de Jong, 1990). Pennock and de Jong (1990) presented values for net soil export from cultivated land in Saskatchewan where net soil losses ranged from 5.2 to 11.2 tonnes/hectare/year depending on soil type (Table 4.2).

These soil erosion rates may be overestimated due to the adoption of no-till cropping practices since Pennock and de Jong (1990) completed

Table 4.2 Soil Type and Erosion Rates

Soil Type	Net Soil Export (tonnes/ha/yr)	Net Soil Export (tonnes/acre/yr)
Brown	- 8.2	- 3.3
Dark Brown	- 11.2	- 4.5
Black	- 5.2	- 2.1

Source: Pennock and de Jong (1990)

their study. No till cropping systems are currently being used by 60% of Saskatchewan producers, however the remaining 40% still use tillage practices that result in increased susceptibility to soil erosion (Statistics Canada Agriculture Census Data, 2006). Pennock and de Jong also mention that net soil erosion rates may not be the best measure of soil redistribution as their study found mean soil losses of up to 19.7 tonnes/hectare/year in some locations. Given the wide range of erosion rates, those presented by Pennock and de Jong may be considered reasonable.

The idea of soil erosion still being a problem in Saskatchewan is supported by a more recent study conducted by Agriculture and Agri-Food Canada - Agri-Environment Services Branch. The study looked at the potential for wind, water and tillage erosion and soil organic matter decline in Saskatchewan and showed that (based on 2001 agricultural practices) these issues can be ranked as follows: organic matter decline > tillage erosion > wind erosion > water erosion. The assessment showed that a significant proportion of land base for each of these issues is within the negligible to low category. This may seem like good news but the report suggests that effects of erosion may be difficult to perceive because they tend to occur in small incremental amounts over long periods of time. Because of this, even low to moderate rates of erosion can cause problems in the long term (Agri-Environment Services Branch, 2006).

"Maintaining cover on the landscape reduces both wind and water erosion thus in effect reduces sediment loading in water sources."

Maintaining cover on the landscape reduces both wind and water erosion thus in effect reduces sediment loading in water sources. Fox and Dickson (1990) estimated the annual cost of water treatment to remove sediment from the water column to be, on average, $13.44/tonne. This study was based on water treatment attributable to cropland erosion in southern Ontario, therefore could be somewhat high for comparison to Saskatchewan based on the relatively lower water demand in this province. However, a recent project in Saskatchewan saw Lake Wascana in Regina drained and 2.4 million tonnes of sediment removed from the lake bottom at a cost of $18 million (Clifton

Table 4.3 Forage Acres in Saskatchewan by Soil Zone and Cost Saving Value in Sediment Removal

	Soil Zone		
	Brown	**Dark Brown**	**Black/Gray**
Tame forage acres[a]	3,262,532	2,242,990	4,689,890
Native forage acres[a]	5,499,552	2,430,034	4,860,069
Total forage acres	8,762,084	4,673,024	9,549,959
Soil erosion rate (t/ac/yr)[b]	-3.3	-4.5	-2.1
Cost to remove sediment ($/t)	$10	$10	$10
Savings from Forage Land (in Millions $)	**289.1**	**210.3**	**200.5**

[a] *Based on SAMA data (2009) applied to Statistics Canada (2006) data (see Appendix B for data and method of compilation)*

[b] *Based on Pennock and de Jong (1990)*

Associates, unpublished data). Thus, the average cost for removing sediment from Lake Wascana was $7.50/tonne. Using the Pennock and de Jong (1990) values for soil erosion rates, total acres of forage for each soil zone in Saskatchewan and the average cost to filter or remove sediment (estimated $10 per tonne), the value of keeping forage on the landscape ranges from $200.5 million to $289.1 million annually for black/gray to brown soils, respectively (Table 4.3). This example assumes forage covered land represents a saving in the cost to remove sediment which would be eroded if the land was under cultivated crop production.

By adding the value of forages in erosion control from each soil zone, the total value of keeping current acres in forage is estimated at $700 million annually. A range can also be estimated based on the removal cost of $7.50/tonne (Clifton Associates, unpublished data - Wascana project) as a low and $13.44/tonne (Fox and Dixon - Ontario data) as a high with the result of $525 - $940.7 million annually. This value represents the savings in sediment removal from water sources due to reduced soil erosion from land with permanent cover.

4.2 Consumptive Wildlife Use

Saskatchewan is one of the premier hunting locations in North America for both big game and game birds. Maintaining and restoring wildlife habitat is vital to the success of this industry and sustaining this resource. Past studies have shown that vegetative cover (forages) on the landscape is more productive for wildlife populations than annual cropland (Johnson and Igl, 1995, Selting and Irby, 1997, McMaster et al., 2005). These studies ranged from looking at native ungulate land preference (Selting and Irby, 1997) to the breeding success and bird populations on land under various agricultural uses (Johnson and Igl, 1995 and McMaster et al., 2005). The study regarding native ungulate land use found that mule deer, white-tail deer and antelope all preferred tame forage land during the fall (time of year that corresponds to most hunting seasons). This study also found that these ungulates seemed to use growing annual crop land only briefly during the spring, but used native rangeland year-round (Selting and Irby, 1997).

Saskatchewan's Ministry of Environment commissioned several studies in 2006 on the economic evaluation of hunting in Saskatchewan and showed that total expenditures on non-outfitted hunting (Saskatchewan and Canada residents as well as non-residents) for big game and game birds per year totalled $68.3 million. Outfitted hunting trips in Saskatchewan for big game and game birds accounted for $39.2 million. Combined game bird and big game hunting activities totalled $107.5 million annually in Saskatchewan. Although the total combined value cannot be linked solely to forage acres given that some hunting activities likely take place in areas other than forage land, based on the studies of wildlife preference for land types, forage land appears to provide a significant benefit to a number of wildlife species.

"The estimated contribution of forage land to hunting in Saskatchewan ranges between $53 - $107 million annually."

For example a study by Feather et al. (1999) examined how the presence of Conservation Reserve Program (CRP) land affects pheasant populations and the value of hunting pheasants in the Northern Plains of the US. Feather et al. (1999) calculated a consumer surplus for CRP land by looking at the contribution of CRP to pheasant hunting. Using regional estimates of CRP acreages, a per acre benefit to pheasant hunting was derived. In the Northern Plains region (US states closest to Saskatchewan) a consumer surplus of $3/acre/year was calculated for pheasant hunting in CRP. If we assume that pheasants in Saskatchewan are primarily found in native range and tame seeded pasture (acres reported in Table 4.1), the total annual value is estimated at $52.9 million. This estimate is likely low given that a consumer surplus is the amount of money above and beyond the market price that a consumer would be willing to pay for a given good or service. Furthermore, game bird hunters hunt other types of game birds such as waterfowl. Thus, the estimated contribution of forage land to hunting in Saskatchewan ranges between $53 and $107 million annually.

4.3 Non-Consumptive Wildlife Use

Undisturbed vegetative cover such as that provided by forage land represents a range of habitat for wildlife species in Saskatchewan. For example the Prairie Pothole region of Saskatchewan provides important breeding and waterfowl habitat as well as habitat for other migratory bird species. Grassland bird populations have decreased over the years due to loss of habitat, thus remaining forage land represents an important value for these species. Additional to this important bird habitat, forage land represent both cover and forage for a variety of mammals, wild ungulates and reptiles.

Saskatchewan boasts an immense array of wildlife including a number of species at risk (e.g. Swift Fox, Sprague's Pipit, Burrowing Owl, etc.). Many residents and visitors in this province are willing to expend money to observe wildlife. An Environment Canada (2000) study shows residents of Saskatchewan spending $39.3 million annually on wildlife viewing and on average $17/day of participation where expenditures included accommodation, transportation, food and equipment. Feather et al. (1999) calculated a consumer surplus for the contribution of CRP to wildlife viewing. This was modeled by examining changes in wildlife populations induced by CRP which in turn influenced public participation in wildlife viewing. They assumed that there was a relationship between land use and wildlife viewing trips. A consumer surplus of $3.01/acre/year was calculated for the Northern Plains which typifies land use most similar to Saskatchewan. If we assume that most wildlife viewing takes place on native range and tame pasture (acres noted in Table 4.1), wildlife viewing recreation could be conservatively valued at $53 million/year (17,638,412 acres x $3.01/acre). Thus, the range of estimated value from wildlife viewing would be between $39 and $53 million/year.

" Saskatchewan boasts an immense array of wildlife including a number of species at risk."

Table 4.4 Gross Drainage Area for Sport-fish Bearing Lakes/ Reservoirs in the Prairie and Parkland Areas of Saskatchewan

Lake/Reservoir	Drainage Area (km^2)[a]	Forage Area (km^2) 10%	Forage Area (km^2) 25%
Diefenbaker	22,853	2,853	5,713
Rafferty	6,179	618	1,545
Alameda	5,773	577	1,443
Boundary	3,528	352	882
Last Mountain	14,592	1,459	3,648
Lake of the Prairies	15,967	1,597	3,992
Blackstrap	6,705	671	1,676
Echo	38,194	3,819	9,549
Pasqua	38,052	3,805	9,513
Mission	39,017	3,902	9,754
Katepwa	39,757	3,976	9,939
Crooked	44,385	4,439	11,096
Round	45,841	4,584	11,460
TOTAL	**320,843**	**32,084**	**80,210**

[a] *Source: Incremental Gross Drainage Areas of the PFRA Watershed Project (gross), The PFRA WATERSHED PROJECT, Current Version (4) - 2003.12.18*
1 km^2 = 247 acres

4.4 Recreational Fishing

Saskatchewan is well known throughout North America for its fishery resources, particularly in the northern regions of the province. However, excellent fishing opportunities exist in the Prairie and Parkland areas as productive streams and lakes are located throughout the landscape. Environment Canada estimated that residents of Saskatchewan spent $95.4 million annually on recreational fishing with an average annual expenditure per person of $557/year or $29/day of participation (Environment Canada, 2000). In 2006, Saskatchewan Environment commissioned several reports on the economic valuation of fishing in Saskatchewan and showed that total expenditure for non-outfitted fishers in Saskatchewan (including Saskatchewan residents, Canadian

Based on the 13 largest drainage areas south of the boreal region in Saskatchewan, forage land contributes $2.2 - $ 5.5 million per year to recreational fishing.

residents, and non residents) was $156.6 million. Since some of this value is associated with fishers using lakes and streams in the non-agricultural area of the province, the current report will attempt to take into account the larger lakes in the agricultural region of the province and estimates expenditures for those lakes using data from the Saskatchewan Environment (2006) reports.

Feather et al. (1999) estimated the consumer surplus for freshwater based recreation including fishing to be $0.28/acre/year in the Northern Plains. The consumer surplus was calculated from the difference between achieving a "swimmable" water quality goal between existing and no-CRP erosion rates. In this case, it was assumed that as water quality improves, recreational fishing also increases due to the improved habitat conditions. This value for fishing was combined with drainage areas for 13 Saskatchewan reservoirs with fish bearing waters to estimate the value of these drainage areas (based on 10% or 25% of the drainage area as grasslands). Actual land cover in these drainage areas was not available, so two estimates are included (10% or 25% forage - Table 4.4). The total value of forage in these drainage areas was estimated at $2.2 million to $5.5 million annually (based on a value of $0.28/acre/year). These 13 drainage areas represent the largest sport fishing waters in the Prairie and Parkland region of Saskatchewan.

4.5 Climate Change Services

Carbon sequestration is included as part of the indirect benefits from forage due to the carbon sequestration provided by current forage acres in Saskatchewan. While the focus here will be on the ecological service of carbon sequestration provided by the current acreage of forage in Saskatchewan, the previous discussion of carbon trading in the direct section of this report focused on the potential for forage land to generate carbon offsets in the cash market.

The Intergovernmental Panel on Climate Change (IPCC, 2006) reported that the warming of the world's climate system is unequivocal based on increasing global air and ocean temperatures, widespread melting of snow and rising sea levels. The IPCC suggests that warming is primarily due to greenhouse gases being released into the atmosphere. Greenhouse gas emissions have increased 70% between 1970 and 2004 with most of the increase due to burning of fossil fuels and changes in land use. Disturbances to the land such as conversion of grasslands to annual cropland tend to release carbon into the atmosphere and contribute to the increase in greenhouse gases. On the other hand, conversion of annual cropland to perennial cover has been shown to sequester carbon in the soil and root systems of plant reducing atmospheric greenhouse gases.

Research conducted in Saskatchewan has suggested that conversion of annual cropland to perennial cover can result in carbon sequestration rates of between 0.6 - 1.2 Mg C/hectare/year (2.2 - 4.4 tonnes CO_2e/hectare/year) on Gray and Black soils (Mensah et al, 2003) and between 0.3 - 2.9 Mg C/hectare/year (1.1 - 10.6 tonnes CO_2e/hectare/year) on brown and dark brown soils (Nelson et al, 2008). This rate of carbon sequestration can be assumed to be similar for existing Saskatchewan pasture and hay fields. Interestingly, Conant et al. (2003) showed that carbon sequestration rates on grasslands could be changed due to management changes such as fertilization (0.3 Mg C hectare/year), introduction of legumes (0.75 Mg C hectare/year), earthworm introduction (2.35 Mg C hectare/year) and improved grass species (3.04 Mg C hectare/year). Thus, management improvements that increased forage production tended to increase soil carbon storage rates.

Presently, the only province to have legislation and protocols for reducing greenhouse gases is Alberta. During 2008, the price for CO_2e ranged from $9-14/tonne (average $11.50/tonne), with prices

Table 4.5 Current Carbon Sequestration Value from Forage Land in Saskatchewan

	Soil Zone		
	Brown/Dark Brown	**Black/Gray/Dark Gray**	**Total**
Area of forage land (ha)	5,436,995	3,864,731	**9,301,726**
CO_2e Sequestration rate* (t/ha/yr)	5.85	3.3	
CO_2e Sequestered (t/ha/yr)	31,806,421	12,753,612	**44,560,033**
Value of CO_2e** ($/t)	$0.95	$0.95	**$0.95**
Potential Yearly Value ($)	30,216,100	12,115,931	**42,332,031**
Potential Yearly Value ($/ha)	5.56	3.14	**4.55**

**Median value from research conducted by Nelson et al, 2008 and Mensah et al, 2003 converted to CO_2 equivalents.*
***Based on average value for carbon during 2009 on the CCX ($/tonne CO_2)*

expected to fluctuate as the market develops. Another source of price information for carbon in North America is the Chicago Climate Exchange (CCX) which has a much lower value for carbon based largely on the uncertainty surrounding government policy on GHGs. The 2009 average value for carbon on the CCX was $0.95 per tonne of CO_2e. Using these prices, carbon sequestration rates and the area of forage in the various soil zones, the current value of carbon sequestration by forages in Saskatchewan can be estimated (Table 4.5).

Current forage acres represent a value of $42.3 – $512.4 million in carbon sequestered annually.

Based on the 2009 average value of carbon on the CCX, current forage acres represent a value of $42.3 million in carbon sequestered annually. At the 2008 Alberta price for carbon, this value increases significantly to $512.4 million annually.

4.6 Pollination Services

Natural landscapes including forage lands are valuable in providing habitat for insects that pollinate agricultural crops. Conversion of grassland into annual cropland is a major threat to diminishing natural ecosystems and has been shown to have a significant economic impact on agricultural production. Globally, the economic benefit provided by pollinating insects such as wild bees has been estimated to be 153 billion euros or $217 billion US each year (Gallai et al., 2009). Morandin and Winston (2006) conducted a study in Alberta where they estimated the economic value of having forage land adjacent to annual cropland and how pollination of canola was improved due to the abundance of wild bees coming from adjacent natural lands. They showed that seed set was greatest in fields with the highest bee abundance and fields with the highest bee abundance had more uncultivated land within 750 metres of field edges. Another benefit of maintaining grasslands or converting cropland to forage is there are typically fewer insecticides applied to grasslands versus croplands thereby enhancing survival of pollinators. Grasslands also serve as reservoirs for beneficial insects that can assist in keeping pests of crops at bay. Thus, maintaining forage acres results in reduced pesticide use and

"Conversion of grassland to annual cropland is a major threat to diminishing natural ecosystems."

survival of insects beneficial to farmers.

Costanza et al. (1997) estimated the economic value of pollination services from published sources to be $25/hectare/year. Thus, it can be estimated that the annual economic value of forage land for pollinators could be as high as $232.7 million ($25/hectare/year x 9,308,437 hectares). While not all forage land provides preferential habitat for pollinators (e.g. silage crops), the reduction in pesticides use on these crops compared to more intensively produced annual crops does provide benefits for pollinator survival.

4.7 Total Indirect Value Generated by Forages in Saskatchewan

The non-market value of Saskatchewan's forage acres are substantial as the literature reviewed for this paper suggests a value in the range of $894.5 million - $1.9 billion annually (Table 4.6). Interestingly, the largest indirect values were derived from erosion control, carbon sequestration and pollination services. The value of forages to wildlife in Saskatchewan is also substantial, both through consumptive use (hunting/fishing) as well as through non-consumptive use or aesthetic appeal. These data provide evidence that there is significant indirect value derived from the current forage acreage in Saskatchewan. These ecological goods and services play an important role in the total value of forages to the economy, environment and society of Saskatchewan.

Table 4.6 Estimated Indirect Value Generated by Forages in Saskatchewan

Indirect Benefit	Value Range (Millions $/yr)
Erosion Control	525.0 - 940.7
Wildlife - Consumptive Use [a]	53.0 - 107.5
Wildlife - Non-consumptive Use [a]	39.3 - 53.0
Recreational Fishing [b]	2.2 - 5.5
Carbon Sequestration [c]	42.3 - 512.4
Pollination Services [d]	232.7
TOTAL	**$894.5 million - 1.9 billion**

[a] *Based on use within native range and tame pasture acres*
[b] *Low number based on drainage areas with 10% forage cover; high number based on drainage area with 25% forage cover*
[c] *Based on $0.95 or $11.5 per CO_2e*
[d] *Based on Costanza et al. 1997*

5.0 ADDITIONAL NON-MARKET VALUE FROM FORAGES

5.1 Foregone Government Program Costs

Government income support assistance on annual cropland is generally greater than on native grasslands and tame forage, therefore maintaining forage on the landscape or conversion of marginal land to perennial cover will reduce government expenditures on assistance payments. In Saskatchewan there has been a number of government assistance programs related to crop production such as Saskatchewan Crop Insurance Corporation (SCIC), Canadian Agricultural Income Stabilization (CAIS), Canadian Farm Income Program (CFIP) and other ad hoc programs which provide payments to farmers who experience crop failures or wide variations in annual income. For example, the ten year average for cropland damages and failures paid out by Saskatchewan Crop Insurance Corporation (SCIC) from 1999 - 2008 was $283 million/year or an average of $7.65/acre of annual cropland (Table 5.1). Thus, maintaining forage on the Saskatchewan landscape and not converting to annual crops could on average save governments annual payments of $176 million dollars ($7.65/acre x 23 million acres of forage). Furthermore, when crop disasters occur, SCIC pays out more than the average $7.65/acre and total payments on cropland can exceed $1 billion.

Table 5.1 Saskatchewan Crop Insurance Payments per Acre (2006)

Year	Total Payments ($ millions)[a]	Payment Per Acre of Cropland[b]
1999	95	2.56
2000	133	3.59
2001	332	8.97
2002	1090	29.46
2003	345	9.32
2004	392	10.59
2005	76	2.05
2006	126	3.41
2007	137	3.70
2008	99	2.68
10 Year Average	**283**	**7.65**

[a] *Saskatchewan Crop Insurance Corp. Annual Reports 1999-2008*
[b] *Assumes that total cropland acres remain constant at 37 million acres in SK*

In 2006 - 2007 (corresponding crop year to the 2006 Statistics Canada Census of Agriculture), the Agriculture and Agri-Food Canada data book on government transfers by province (2009 Update) shows income support and stabilization expenditures in support of the Agri-Food Industry in Saskatchewan totalled $726 million. If it is assumed that 50% of these payments went to crop producers, the average payment per acre of annual cropland would be $9.81. Thus, the savings in annual government stabilization payments to maintain forage on the landscape would be $225.6 million ($9.81/acre x 23 million acres of forage).

When both crop insurance payments and government stabilization programs are considered, the total savings for maintaining forages in Saskatchewan at the current acreage represents a value of $401.6 million annually.

5.2 Land Set Aside Programs

Over the years, the damaging effects caused by cultivation of marginal land for use as annual cropland have been well documented (Kiss et al., 1986; Pennock and de Jong, 1987; McGill et al., 1988; Bowman et al, 1990; Pennock and de Jong, 1990; Janzen et al., 1998). Government and conservation organizations have both been active in developing programs that assist producers re-establish perennial cover on fragile soils. Depending on the program type or the organization's goals, different types of land will be targeted. For example, Ducks Unlimited Canada has a land conversion program that targets duck habitat and surrounding areas while some government programs are based on soil classifications. Depending on the program type, producers are normally required to sign an agreement that states the land will be left in permanent cover for a specific period of time.

An example of one such program is the Greencover Canada Land Conversion Program (GCLC). This national program was offered in Canada between 2004 - 2009 where producers were offered a seeding and establishment payment of $45/acre for tame forages and $100/acre for native forages on qualified acres. Through this program, 543,379 acres were converted in Canada, with 291,075 tame acres and 17,624 native acres re-established in Saskatchewan (Agriculture and Agri-Food Canada - Agri-Environment Services Branch, personal communication). These numbers represent the total number of "current" acres in the GCLC Program. Current acres are defined as the total number of acres that were seeded and established under the GCLC contract which have not been cancelled (due to activities such as sale of land).

While the current acres from this program represented a transfer of approximately $25 million to Saskatchewan producers, these dollars were allocated to cover the cost associated with establishing forages rather than representing a generation of income.

The only way that forage land can generate economic income from programs without harvesting are land set aside programs. In these instances a producers agrees to not use a parcel of land for agricultural activities, including haying and grazing. These programs are often through conservation agencies in an effort to provide habitat for wildlife or protect environmentally sensitive areas. One such example, 'Wildlife Tomorrow', is offered through the Saskatchewan Wildlife Federation. However, this program is considered a "gentlemen's agreement" and does not include a formal contract or exchange of money. Also, due to the nature of these agreements, the Saskatchewan Wildlife Federation does not keep a record of acres or participation in this program.

Conservation easements represent another type of land agreement that producers may enter into regarding land use. However, these are varied in their land use potential and generally only provide land owners with tax deductions rather than actual income.

Value of preserving wildlife habitat and ecological goods and services provided by this land base has been covered in the non-market section of this report.

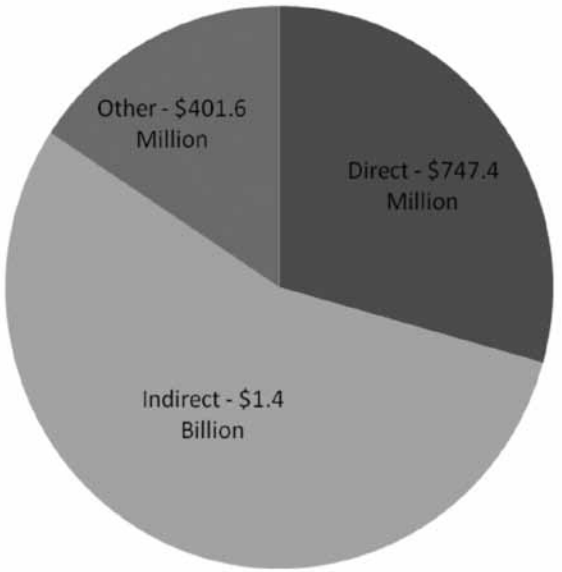
6.0 TOTAL VALUE GENERATED BY FORAGES

Through extensive research and stakeholder consultation, this report has clearly quantified that forages are an important resource in Saskatchewan both in economic and environmental terms. Forages are the foundation for the ruminant livestock industry in Saskatchewan generating a significant value through hay and pasture. This commodity represents a significant contribution to the export industry, seed sector, sod and turf industry and emerging alternative fuel markets. There is also significant potential for producers to realize economic returns from their forage acres through carbon trading markets. There are less obvious, but important links between forages and industries such as tourism and parks which rely on forage resources in their appeal to travelers. As determined in this report, direct economic value generated by forages is estimated at $747.4 million annually, with the potential to grow and create value through a number of sectors in the future. For example, there is potential to realize an additional $11.2-$137 million depending on the policy direction surrounding carbon trading. The current economic value of $747.4 million is generated through economic activity associated with the wide variety of industries and sectors mentioned above.

In addition to the direct economic value generated by forage land, there are a number of indirect benefits generated by this resource. These benefits provide services to both the land owner and the public through their connection to the environment and public resources. Indirect benefits include erosion control, flood control, water quality, wildlife habitat, pollination services and carbon sequestration. These ecological values are more difficult to determine and are presented here as a range. As outlined by this report the indirect value provided by forages in Saskatchewan is approximately $894.5 million - $1.9 billion/year.

This report also determined that forages create non-market value through savings to government programs in the range of $401.6 million annually.

Figure 6.1 Total Value from Forages in Saskatchewan



In total, *the direct and indirect value of forages in Saskatchewan is estimated at $2-$3 billion annually.*

Industry consultation was a major component of this project both through direct one-on-one contact with stakeholders as well as through stakeholder forums held in November of 2008 and November of 2009. This consultation process provided an opportunity for those associated with the forage industry to voice opinions regarding issues facing the industry as well as where opportunities for growth and expansion exist. Please refer to Appendix A for a list of agencies and individuals consulted during the course of this project.

7.0 ISSUES AND OPPORTUNITIES FOR THE SASKATCHEWAN FORAGE INDUSTRY

7.1 Issues Facing the Saskatchewan Forage Industry

One of the main issues facing the forage industry noted by stakeholders is the general lack of prominence of the forage industry with respect to other crops. Annual crops remain the focus of many producers as well as for governments both on a provincial and federal level likely due to the nature of the forage industry and the fact that it is often integrated into, or supportive of, other industries (for example, the livestock industry). It was noted that segmentation of the forage industry limits the influence that the industry commands. Segmentation in the forage industry has developed over time as a means to focus on sector-specific issues. However, many stakeholders have recognized this issue, and have begun to work towards cooperation between sectors of the forage industry - with the benefit of the entire industry in mind.

Another issue facing the industry is the lack of information and statistics relating to forages. One such example is the data collected by Statistics Canada through the Agriculture Census. This data provides limited value for the forage industry as the information is generalized, with a lack of regional focus applied to the surveys. For example, acreage of corn silage is collected on the Western Canada survey, when in reality this crop is more important in Eastern Canada. Barley silage acreage reported by Western Canada growers would be much more valuable. Also, where there is separate reporting for almost all major annual crops, several categories of forage types and crops are combined on the Census survey.

Accuracy of statistics is questionable for a number of forage sectors and in particular for hay export. Industry specialists and producers indicated that figures reported for hay export are not likely reflective of actual exports. Due to the reporting requirements for hay export, estimated tonnage and value for exported hay are thought to be well below actual. The result is that a significant portion of the economic activity generated by this forage sector cannot be accurately represented.

One of the major barriers to growth mentioned by the forage export sector was transportation. Current transport costs are increasing and Canadian rates are not competitive with US rates. An example of this disparity was provided as part of a report to the Manitoba Forage Council regarding export forage potential. The freight rate for forage products from Salt Lake City, Utah to United Arab Emirates (UAE) was $1600/container (25 tonnes), while the rate from Calgary to UAE was $2700/container (Manitoba Forage Council, 2009). Before the removal of the *Western Grain Transportation Act*, in the mid 1990's, processed forages were included in the specialty crop rates. Currently forages are not included in the specialty crop transport rates. Canadian exporters pursuing overseas markets are experiencing a shortage of containers necessary to reach these markets thus reducing their effectiveness in the market place. The issue, according to many exporters is not the lack of containers, but a number of the policies surrounding the use of ocean containers. Current Canadian policies indicate containers must be returned to port very quickly, while in the US, containers are available more frequently with fewer restrictions. Another concern expressed by forage exporters was the labour relations with the ports and railways. This issue appears to be a common concern for agricultural commodities, as work stoppages affect exporters' ability to move commodities in an efficient manner.

Another hurdle mentioned by many stakeholders is that the livestock industry, the largest user of forages in Saskatchewan, is currently under considerable strain. The beef industry in particular is experiencing a contraction due to a number of factors including regulatory changes, the strong Canadian dollar (relative to the US dollar), poor prices and a decrease in global demand linked to the global economic downturn. This situation has resulted in some producers reducing forage acres due to a decrease in demand for forage products either from their own operation or from customers.

The forage industry is under pressure due to competition for land, including annual cropping, urban sprawl, recreation areas and other developments. Annual cropping has a significant impact on forage

seed acres in particular, as often growers of forage seed are also annual crop producers who will rotate acres when market signals indicate an economic benefit to reducing forage acres.

Another concern raised by stakeholders is the marked reduction in funding for forage research, breeding and development programs in Canada. The forage industry does not have any form of check off (with the exception of the forage seed industry), therefore depends on private and public funding for research and development. The Canadian Cattlemen's Association identified this issue and commissioned a study of such programs in 2008. This study discovered that during the period between 1985-1998 public funding for forage breeding and research program decreased from $41 million to $19 million. The findings of this study also reported that in 2007 there remained only four forage breeding programs in Canada and three active forage breeders (Canadian Cattlemen's Association, 2008). Due to limited resources, funding for forage research is often short term in nature. This is troubling to many as long-term scientific research and development programs are necessary both to attract young professionals to this field, as well as for future success and advancements in the industry.

A measure of the challenges in the forage research field was demonstrated by Jefferson and Selles (2007) when they conducted a study looking at long-term forage yields. It was reported that forage yields have declined over the past 30 years, due in part to changes in climate, infrequent fertilization and insufficient stand rejuvenation. The study suggested that forage research is necessary to improve this situation for the wider industry.

During the consultation process, a number of industry specialists and producers noted the ongoing importance and focus that must continue to be placed on extension and technology transfer activities. Education for producers and increased awareness of information regarding management and production of forages is essential. Many specialists noted that a significant portion of forage acres are not under optimal management, illustrating the ongoing need to assist producers by providing education opportunities and the resources to assist 'on the ground'. Programs and funding focused on this area are essential in order to have a positive effect on the entire industry.

7.2 Opportunities for the Saskatchewan Forage Industry

One of the major opportunities for the forage industry in Saskatchewan noted by industry stakeholders was to strengthen the link with the livestock industry. As forages provide the basis for much of the livestock production in this province, an opportunity and need was identified for the forage industry to raise awareness, work in partnership and strengthen the link between these stakeholders. Many in the livestock industry do acknowledge the importance of the forage industry. An economical source of forage through pasture, hay and crop residues is a key resource in maintaining a competitive advantage in the global marketplace. There may be opportunities to work more closely with livestock organizations to support forage-related programs.

Another opportunity for the forage industry is the link to organic livestock production. Although this is currently a small portion of livestock production as a whole, forages play an important role in producing organic products of various types ranging from cattle to chickens. Demand for organic food has been on the rise over the past number of years and predictions are for this trend to continue. There is currently not a large organic forage industry in Saskatchewan however, this is identified as a potential area of focus in the future. Forages also have a role in organic crop production as a source of organic nitrogen when used in crop rotations. This use of forages is also projected to grow along with the demand for organic crop products.

Depending on the development of government regulations surrounding climate change, the carbon market is predicted to grow significantly. This could be an important economic opportunity for forage land owners to capitalize on the carbon trading market. However, this potential remains largely hypothetical. Carbon trading requires that protocols

be developed and adhered to as demonstration that carbon is in fact being sequestered or carbon emissions reduced. Currently there are few protocols that relate directly to forage land, therefore work in this area will be needed to realize the full potential for carbon trading from forage acres.

The horse industry is also a significant user of forages in this province and the link between the forage industry and these sport/companion animals should be strengthened going forward. As horses are largely considered recreational in use rather than agricultural livestock, the forage industry will have to work with the horse industry to determine needs and identify opportunities for partnerships in the future.

The agri-tourism industry in Saskatchewan presents significant opportunity. Interest in this sector is growing and often activities associated with agri-tourism rely either directly or indirectly on forage land. The link between native grassland, or perennial grassland cover and nature viewing, aesthetic appeal as well as hiking and biking trails is becoming apparent. Currently there is not sufficient data collected regarding agri-tourism operations to measure their contribution to the tourism industry as a whole. More information on this sector would be helpful in addressing the opportunities that appear to exist.

As mentioned in the direct economic section of this report, there is also potential for forages to be used in the fuel industry including cellulosic ethanol production and alternative heating fuel sources. This is another area that will largely depend on government regulation and funding paths. For example, if government funding is focused on cellulose ethanol production, the potential market for forages in this production process may grow significantly. There is also potential for industrial products such as composite board and soil amendments to be manufactured from forage products.

The processed forage sector is currently exploring the Middle East as a growing market for forage exports. Regulatory changes by Middle Eastern governments have reduced domestic capacity of forage production, making forage imports necessary to maintain livestock production in this region in the future. There are interested parties in Canada currently pursuing access to this region and indicate that to fully exploit this opportunity, a presence in the region will be necessary and logistical issues will need to be addressed.

While the majority of forage acres in Saskatchewan are produced under dryland conditions, there are pockets of irrigation located around the province. In these irrigated areas, forages are often included in the crop rotation. In the future, there may be potential to expand both the area of irrigation and the number of acres of forage crops under irrigation as a means of expanding forage production in Saskatchewan.

The native seed sector has indicated that buyers are increasingly interested in using native seed in a variety of situations. Due to the lack of information in this sector it has not been possible to quantify this demand. Stakeholders have noticed that large orders for native seed are being directed to Alberta growers as there are not sufficient supplies in Saskatchewan. The Native Plant Society of Saskatchewan suggests that studying this sector of the forage industry would provide valuable information regarding opportunities that exist.

Finally, consultation with individuals working on First Nations agriculture issues has indicated that there is potential to engage Aboriginal land managers as part of the wider forage and agricultural industry in Saskatchewan. The First Nations Agricultural Council of Saskatchewan (FNACS) was recently dissolved leaving a void in this role. Existing reserve land and current land claims suggest that First Nations groups may soon control over 3 million acres of agricultural land in Saskatchewan (personal communication). Once land claims have been dealt with, large tracts of land ownership are expected in the east central and northwest portions of Saskatchewan. It will be important for the forage industry to forge a relationship with Aboriginal land owners to ensure these land managers are part of a thriving industry.

7.3 Forage in Saskatchewan's Future

This report demonstrates the clear value created by forages and the benefits to Saskatchewan both in economic and environmental terms. From the extensive research and consultation conducted for this report, a number of common themes were identified which may be targeted to assist the forage industry in developing and moving forward.

The link between forage and livestock is clear and must continue to be strengthened. The forage industry is the basis for much of animal agriculture and investment in forage research, development and technology transfer will be of mutual benefit. Also, it is important for all sectors of the forage industry to work collectively to raise the profile of the entire industry. Focused, collaborative efforts will bring awareness from both the public and private sector and potentially increase investments in this vital resource.

Through the process of completing this analysis, identified opportunities for industry focus and investment include (but are not limited to):

- Increased awareness of the forage industry and the importance to the economy and environment;
- Support for long-term forage breeding and research programs;
- Expanded communication and technology transfer programs that target primary producers;
- Improved information flow within the forage industry both provincially and nationally;
- Changes to Canadian transportation regulations as they relate to forage products;
- Potential export markets for forage products;
- Continued research on carbon capture by forage land;
- Building relationships with First Nations land owners;
- Continued research and development of forage crops for the biofuel market;
- Improved tracking and statistics on forages both at the national and provincial level;
- Support for the growing agri-tourism industry; and
- Support for forage seed growers and seed market research in Saskatchewan.

Collectively, Saskatchewan's forage industry must endeavour to address these needs. A concerted effort including focused policy and programs will facilitate growth and expansion across the province. The opportunities exist - actions will see them realized.

8.0 CONCLUSIONS

This compilation of the value of the forage industry in Saskatchewan is the first of its kind. This report provides evidence that forages can be considered with equal importance alongside other agricultural commodities grown in this province. Through extensive research and stakeholder consultation, this study found the total value of the forage industry to be between $2 and $3 billion/year in Saskatchewan. Forages have a significant effect both on the economy and environment in the province through generation of economic activity and provision of many ecological goods and services. This study determined that forages generate $747.4 million/year in direct economic activity and between $894.5 million and $1.9 billion/year in indirect value (environmental services).

It should be noted that the numbers presented here for forage value are gross values, and thus caution must be exercised in comparing to other commodities where costs associated with production may be significantly different. In most cases, forage production costs are lower than those for annual crops, so even though the gross value of other agricultural commodities (such as wheat or canola) may be reportedly much higher, the associated cost of producing these annual crops bring the net value of these commodities down significantly. For example in 2008, Saskatchewan spring wheat reported a gross value of $1.75 billion, barley a gross value of $992 million and canola a gross value of $2.5 billion (Saskatchewan Ministry of Agriculture Crop Statistics and Statistics Canada). These values are calculated by multiplying the tonnes of commodity produced and the average price for the commodity. As stated, the costs associated with producing these annual crop commodities are generally much higher than costs associated with forage production, thus if it was possible to compare net values, forages would likely compare to these annual crops in a favourable way.

The total value of the forage industry is between $2 and $3 billion per year in Saskatchewan.

Consultation with forage industry stakeholders revealed that this industry is essential to a number of agricultural and environmental sectors in the province. Stakeholders also indicated that due to the segmentation in the industry, it has been difficult in the past to draw attention to issues and opportunities existing within. As the forage industry largely depends on public and to a lesser extent, private funding, for research and development, it is necessary to have detailed information to present to both provincial and federal government agencies to encourage programs directed at improving the forage industry.

This study was conducted with the objective of determining the value of the forage industry to Saskatchewan's economy and environment. This information is intended to provide forage industry stakeholders the necessary data with which to approach funding and government agencies. This comprehensive information was not previously available in a single report. This data will aid groups in making informed decisions regarding the future direction of the forage industry.

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APPENDIX A — STAKEHOLDER CONSULTATION

Project Steering Committee:

Ken Belcher, Associate Professor - University of Saskatchewan, College of Agriculture and Bioresources and Centre for Studies in Agriculture, Law and the Environment (CSALE)

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Colleen Christensen, Executive Director - Feeds Innovation Institute (FII)

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Kathy Larson, Project Coordinator - Knowledge Impact in Society (KIS)

Michel Tremblay, Provincial Forage Specialist - Saskatchewan Ministry of Agriculture

Scott Wright, Former Executive Director - Feeds Innovation Institute (FII)

Agencies and Individuals Consulted During Forage Industry Project:

Agriculture and Agri-Food Canada - Agri-Environment Services Branch (AESB - formerly PFRA), Community Pastures Program

Alberta Agriculture and Rural Development - Statistics and Data Development

Alberta Climate Change Central - Carbon Offset Solutions

Alberta Forage Industry Network

Arborfield Dehy Ltd

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Dale Pulkinen, Executive Director - Canadian Dehydrators Association

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Gord Vaadeland, Owner - Sturgeon River Ranch

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Nancy Gray, Executive Director - Saskatchewan Forage Seed Development Commission

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Pickseed

Prairie Agricultural Machinery Institute (PAMI)

Remo Pasteris, Agrologist - Agriculture and Agri-Food Canada

Saskatchewan Association of Rural Municipalities (SARM)

Saskatchewan Cattle Feeders Association

Saskatchewan Cattlemen's Association

Saskatchewan Crop Insurance Corporation

Saskatchewan Horse Federation

Saskatchewan Ministry of Agriculture - Crop Development Branch

Saskatchewan Ministry of Agriculture - Irrigation Development Branch

Saskatchewan Ministry of Agriculture - Lands Branch

Saskatchewan Ministry of Agriculture - Livestock Development Branch

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Western Beef Development Centre

Wilbur Ellis

Yvan Beaulieu, Senior Market Development - Agriculture and Agri-Food Canada

APPENDIX B — SAMA DATA

The following information was provided by Saskatchewan Assessment Management Agency (SAMA) regarding data summarized for this report:

Considerations when using the data:

- Re-inspections are carried out each year. Currently, there are Regulations that mandate re-inspection of rural municipalities at least every 16 years. However, SAMA is behind in the re-inspection cycle. The data in some municipalities may be as current as last year and the data in some municipalities is up to 30 years old

- Acres of land that have been cultivated, seeded back to grass, valued as cultivated land, and have a non-arable tax class are included separately. Land that has been seeded to grass, valued as cultivated land, and have an arable or non-arable tax class were included separately as well.

Raw data from SAMA - summarized and provided in October, 2009

Pasture Summary Tables

Column	Description
Type	Native – native pasture Improved – tame grass/seeded pasture Reverted/Reverting – cultivated at one time but reverting to native grass species
Soil Zone	Brown Dry, Brown Moist, Dark Brown, Black, Dark Gray, Gray Wooded and transitions between zones
Tree Cover	Tree covers include Aspen, Aspen/ Coniferous, Coniferous, and Shrub
Acres	Acres of pasture within each stratification

Table 1. Tame Pasture Acres

Type	Soil Zone	Tree Cover	Acres
Improved	Black	Aspen	260
Improved	Black	Coniferous	139
Improved	Black	Shrub	3,679
Improved	Black		133,206
Improved	Black/Dark Brown	Aspen	160
Improved	Black/Dark Brown		16,084
Improved	Black/Dark Gray	Aspen	30
Improved	Black/Dark Gray	Aspen/ Coniferous	60
Improved	Black/Dark Gray	Shrub	70
Improved	Black/Dark Gray		17,873
Improved	Black/Gray Wooded		525
Seeded Grass	Black		92,424
Seeded Grass	Black/Dark Brown		6,860
Seeded Grass	Black/Dark Gray		12,877
Seeded Grass	Black/Gray Wooded		119
Improved	Brown Dry	Aspen	97

Table 1. Tame Pasture Acres

Improved	Brown Dry		55,484
Improved	Brown Dry/ Brown Moist		12,077
Improved	Brown Dry/ Dark Brown		6,949
Improved	Brown Moist	Aspen	104
Improved	Brown Moist	Shrub	30
Improved	Brown Moist		174,763
Improved	Brown Moist/ Dark Brown		44,031
Seeded Grass	Brown		71,004
Seeded Grass	Brown/Dark Brown		14,375
Improved	Dark Brown	Aspen	69
Improved	Dark Brown	Shrub	1,044
Improved	Dark Brown		174,459
Seeded Grass	Dark Brown		55,095
Improved	Dark Gray	Aspen	349
Improved	Dark Gray	Aspen/ Coniferous	80
Improved	Dark Gray	Coniferous	15
Improved	Dark Gray	Shrub	500
Improved	Dark Gray		82,416
Improved	Dark Gray/ Gray Wooded	Aspen	60
Improved	Dark Gray/ Gray Wooded	Shrub	205
Improved	Dark Gray/ Gray Wooded		34,248

Table 1. Tame Pasture Acres

Improved	Gray Wooded	Aspen	611
Improved	Gray Wooded	Aspen/ Coniferous	98
Improved	Gray Wooded	Shrub	1,160
Improved	Gray Wooded		139,523
Seeded Grass	Dark Gray		35,946
Seeded Grass	Dark Gray/ Gray Wooded		12,887
Seeded Grass	Gray Wooded		40,283
Reverted/ Reverting	Black	Aspen	53
Reverted/ Reverting	Black	Aspen/ Coniferous	40
Reverted/ Reverting	Black	Shrub	2,347
Reverted/ Reverting	Black		43,929
Reverted/ Reverting	Black/ Dark Brown	Aspen	25
Reverted/ Reverting	Black/ Dark Brown		6,865
Reverted/ Reverting	Black/ Dark Gray	Shrub	35
Reverted/ Reverting	Black/ Dark Gray		5,598
Reverted/ Reverting	Black/ Gray Wooded		220
Reverted/ Reverting	Brown Dry	Aspen	83
Reverted/ Reverting	Brown Dry		54,737

Table 1. Tame Pasture Acres

Reverted/ Reverting	Brown Dry/ Brown Moist		1,244
Reverted/ Reverting	Brown Dry/ Dark Brown		113
Reverted/ Reverting	Brown Moist	Aspen	10
Reverted/ Reverting	Brown Moist	Shrub	25
Reverted/ Reverting	Brown Moist		79,367
Reverted/ Reverting	Brown Moist/ Dark Brown	Shrub	40
Reverted/ Reverting	Brown Moist/ Dark Brown		9,123
Reverted/ Reverting	Dark Brown	Aspen	586
Reverted/ Reverting	Dark Brown	Shrub	986
Reverted/ Reverting	Dark Brown		74,632
Reverted/ Reverting	Dark Gray	Aspen	382
Reverted/ Reverting	Dark Gray	Aspen/ Coniferous	55
Reverted/ Reverting	Dark Gray	Shrub	4,904
Reverted/ Reverting	Dark Gray		10,635
Reverted/ Reverting	Dark Gray/ Gray Wooded	Shrub	1,767
Reverted/ Reverting	Dark Gray/ Gray Wooded		4,118

Table 1. Tame Pasture Acres

Reverted/ Reverting	Gray Wooded	Aspen	1,004
Reverted/ Reverting	Gray Wooded	Aspen/ Coniferous	34
Reverted/ Reverting	Gray Wooded	Shrub	12,894
Reverted/ Reverting	Gray Wooded		27,932

Table 2. Seeded Grass Pasture Rated as Arable

Type	Soil Zone	Acres
Seeded Grass	Black	92,424
Seeded Grass	Black/Dark Brown	6,860
Seeded Grass	Black/Dark Gray	12,877
Seeded Grass	Black/Gray Wooded	119
Seeded Grass	Brown	71,004
Seeded Grass	Brown/Dark Brown	14,375
Seeded Grass	Dark Brown	55,095
Seeded Grass	Dark Gray	35,946
Seeded Grass	Dark Gray/ Gray Wooded	12,887
Seeded Grass	Gray Wooded	40,283

Table 3. Cultivated Land in Pasture Rated as Arable and Non-Arable

Tax Class	Soil Zone	Acres
Arable	BL	303,715
Arable	BL-DG	42,150
Arable	BL-GW	279
Arable	BW	347,360
Arable	BW-DB	32,413
Arable	DB	261,818
Arable	DB-BL	40,474
Arable	DG	116,920
Arable	DG-GW	32,800
Arable	GW	78,630
Non-Arable	BL	92,424
Non-Arable	BL-DG	12,877
Non-Arable	BL-GW	119
Non-Arable	BW	71,049
Non-Arable	BW-DB	14,375
Non-Arable	DB	55,095
Non-Arable	DB-BL	6,860
Non-Arable	DG	35,946
Non-Arable	DG-GW	12,887
Non-Arable	GW	40,331

Table 4. Native Pasture Acres

Type	Soil Zone	Tree Cover	Acres
Native	Black	Aspen	901,058
Native	Black	Aspen/Coniferous	15,180
Native	Black	Coniferous	2,103
Native	Black	Shrub	206,428
Native	Black		1,088,983
Native	Black/Dark Brown	Aspen	44,333
Native	Black/Dark Brown	Shrub	15,311
Native	Black/Dark Brown		168,100
Native	Black/Dark Gray	Aspen	187,848
Native	Black/Dark Gray	Aspen/Coniferous	14,604
Native	Black/Dark Gray	Coniferous	1,259
Native	Black/Dark Gray	Shrub	25,664
Native	Black/Dark Gray		72,086
Native	Black/Gray Wooded	Aspen	1,237
Native	Black/Gray Wooded	Aspen/Coniferous	1,958
Native	Black/Gray Wooded	Shrub	238
Native	Black/Gray Wooded		1,321
Native	Brown Dry	Aspen	3,980
Native	Brown Dry	Shrub	11,130
Native	Brown Dry		1,735,860
Native	Brown Dry/Brown Moist	Aspen	8,965
Native	Brown Dry/Brown Moist	Shrub	75,813
Native	Brown Dry/Brown Moist		468,655
Native	Brown Dry/Dark Brown		1,456
Native	Brown Moist	Aspen	6,212

Table 4. Native Pasture Acres

Native	Brown Moist	Shrub	18,141
Native	Brown Moist		3,355,058
Native	Brown Moist/Dark Brown	Aspen	7,636
Native	Brown Moist/Dark Brown	Shrub	1,764
Native	Brown Moist/Dark Brown		797,079
Native	Dark Brown	Aspen	283,091
Native	Dark Brown	Shrub	161,818
Native	Dark Brown		2,228,648
Native	Dark Gray	Aspen	639,482
Native	Dark Gray	Aspen/Coniferous	183,552
Native	Dark Gray	Coniferous	20,455
Native	Dark Gray	Shrub	44,608
Native	Dark Gray		164,488
Native	Dark Gray/Gray Wooded	Aspen	167,842
Native	Dark Gray/Gray Wooded	Aspen/Coniferous	62,265
Native	Dark Gray/Gray Wooded	Coniferous	6,466
Native	Dark Gray/Gray Wooded	Shrub	8,935
Native	Dark Gray/Gray Wooded		28,875
Native	Gray Wooded	Aspen	1,057,156
Native	Gray Wooded	Aspen/Coniferous	562,083
Native	Gray Wooded	Coniferous	68,012
Native	Gray Wooded	Shrub	28,610
Native	Gray Wooded		100,298

Table 5. Summary of Tame Grass Pasture Acres by Soil Zone

Soil Zone	Acres	% of Total Acres
Black	659,628	23
Dark Brown	639,156	22
Gray	640,455	23
Brown	903,429	32
Total	**2,842,668**	

Source: SAMA (October, 2009)

Table 6. Summary of Native Grass Acres by Soil Zone

Soil Zone	Acres	% of Total Acres
Black	2,519,966	17
Dark Brown	2,901,301	19
Gray	3,143,127	21
Brown	6,491,749	43
Total	**15,056,143**	

Source: SAMA (October, 2009)

Note to SAMA data acquired for this report

The data was sourced from Saskatchewan Assessment Management Agency (SAMA) to give an indication of breakdown of pasture acres by soil zones in Saskatchewan. SAMA is an independent agency that provides reliable, up-to-date property assessment valuations to the provincial government for their various programs relating to land use. SAMA carries out re-inspections of land every year and current regulations mandate that re-inspection of rural municipalities be conducted at least every 16 years. However, the re-inspection cycle is not on target, with data in some municipalities as current as 2008 or up to 30 years old. In spite of these limitations, SAMA data remains the best source of information related to the distribution of land use in the various soil zones of Saskatchewan.

It should be noted that the total acres reported for tame and native pasture were not consistent between SAMA and Statistics Canada. This is expected due to variations in reporting and data collection between the two agencies. Also, as stated above, all SAMA data is not current, while Statistics Canada values are taken from the 2006 Census of Agriculture. For the purposes of this report, the percent of pasture acres reported by SAMA in the various soil zones (as seen in table 5 and 6) will be applied to the Statistics Canada acreage data to determine the distribution of pasture acres across soil zones in Saskatchewan. The percentage of pasture acres was also used to estimate the acres of total forage in the various soil zones for the purpose of estimating carbon sequestration values for forages in Saskatchewan.

APPENDIX C — FORAGE SEED LEVY

Table 1. Forage Seed Species Subject to Saskatchewan Forage Seed Development Commission (SFSDC) Levy

Legumes	Grasses
Sweet clover	Slender wheatgrass
Red clover	Pubescent wheatgrass
Alsike clover	Streambank wheatgrass
Birdsfoot trefoil	Northern wheatgrass
Sainfoin	Tall wheatgrass
Cicer milkvetch	Hybrid wheatgrass
Black medic	Dahurian wildrye grass
	Timothy
	Smooth bromegrass
	Meadow bromegrass
	Hybrid bromegrass
	Crested wheatgrass
	Intermediate wheatgrass
	Altai wildrye grass
	Russian wildrye grass
	Canada wildrye grass
	Reed canarygrass
	Annual ryegrass
	Perennial ryegrass
	Hybrid ryegrass
	Creeping red fescue
	Chewings fescue
	Hard fescue
	Tall fescue
	Meadow fescue
	Fowl bluegrass
	Kentucky bluegrass

Source: Saskatchewan Forage Seed Development Commission – Forage Seed Species Inclusion. Enacted 2005.

APPENDIX D — SASKATCHEWAN CORN HEAT UNIT MAPS

Figure 1 Saskatchewan Accumulated Corn Heat Units
(areas receiving 2200 CHU in 50% of years)

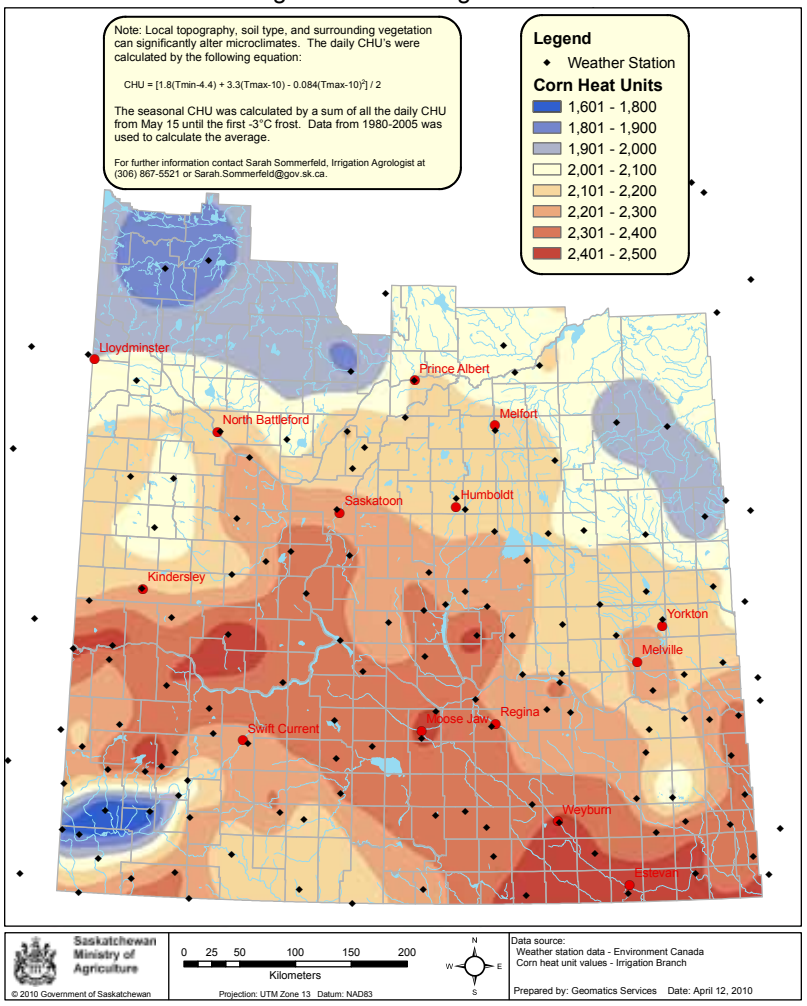
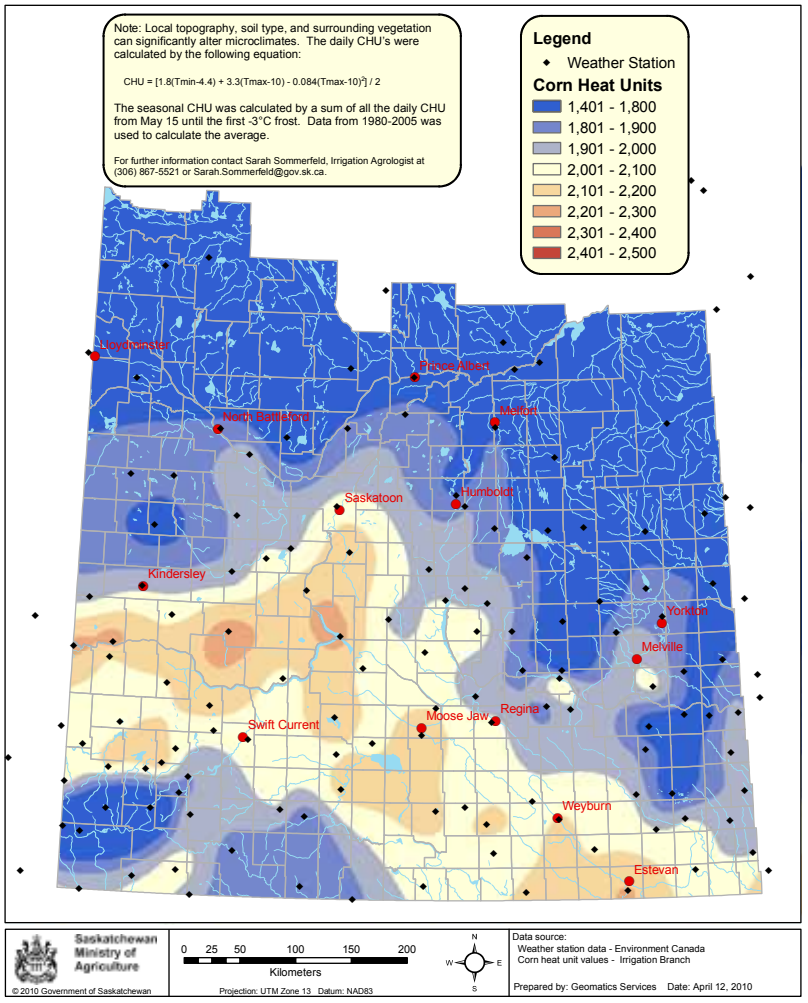


Figure 2 Saskatchewan Accumulated Corn Heat Units
(areas receiving 2200 CHU in 90% of years)



GLOSSARY

Abbreviations

cf.	confer, compare this definition with the definition of words that follow
n.	Noun
v.	Verb
adj.	Adjective

Alfalfa Dehydration or 'Dehy' Alfalfa. A forage product produced from standing alfalfa, which is mowed and chopped in the field, delivered to a dehydrating plant, artificially dried, ground and pelleted or cubed.

Animal-Unit (AU). An animal unit is one, mature, non-lactating bovine weighing 500 kg (1100 pounds) and fed at maintenance level or 2% of body weight (22 pounds per day).

Animal-Unit-Equivalent (AUE). A number relating the forage dry matter intake of a particular kind or class of animal relative to one A.U.

Animal Unit Month (AUM). The amount of dry forage required by one animal unit for one month based on a forage allowance of 22 pounds per day. Not synonymous with animal-month.

The term AUM is commonly used in three ways: (a) Stocking rate, as in "X acres per AUM"; (b) forage allocations, as in "X AUMs taken from unit B"; (c) utilization, as in "X AUMs taken from total units available".

Browse. The parts of shrubs, woody vines and trees available for animal consumption.

Bunchgrass. A graminoid growth habit forming a bunch or a clump.

Carbon Sequestration. The biological process by which carbon is removed and stored from the atmosphere in carbon sinks (such as oceans, forests or soils) through such processes as photosynthesis.

Carbon Sink (aka biological sink). A carbon reservoir that absorbs and stores carbon from another part of the carbon cycle. A sink stores more carbon than it emits to the atmosphere. The main natural sinks are the oceans, soil, plants and other organisms that use photosynthesis.

Carrying Capacity. A measure of an ecological site's sustained forage yield. Carrying capacity is based on a safe utilization level based on mean annual forage production and the plant community's tolerance of grazing pressure. Carrying capacity does not fluctuate yearly in response to forage production and stocking rates, but does fluctuate with weather conditions.

Common Seed. A forage seed grade where there are no field production standards or field inspections, and does not have to be graded by an accredited lab. It is regulated by the *Canada Seeds Act* and regulated to control standards for purity and per cent germination, however the tolerance of weed seeds is generally higher than for other grades of seed. Variety names are not applicable to common seed. Agronomic performance is variable since the seed may be produced from different varieties or non-varieties. One lot of seed may contain seed mixed from more than one source.

Conservation Reserve Program (CRP). The Conservation Reserve Program (CRP) in the United States provides technical and financial assistance to eligible farmers and ranchers to reduce soil erosion, protect the Nation's ability to produce food and fiber, reduce sedimentation in streams and lakes, improve water quality, establish wildlife habitat, and enhance forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices. CRP is administered by the Farm Service Agency, with USDA's Natural Resources Conservation Services (NRCS) providing technical land eligibility determinations, conservation planning and practice implementation.

Consumer Surplus. The amount of money above and beyond the market price that a consumer would be willing to pay for a given good or service.

Crop Residue. Materials left in an agricultural field after the crop has been harvested. These residues can include stalks, stubble, leaves, chaff, seed and straw.

Ecoregion. Broad classes that are determined mainly by climate. Within these ecological regions, rangeland is divided into ecological sites or ecosites, which are defined by more local factors.

Extensive Grazing Management. Grazing management that utilizes relatively large land areas per animal and a relatively low level of labour, resources, or capital. cf. intensive grazing management.

Forage. That part of vegetation that is available and acceptable for animal consumption, whether considered for grazing or mechanical harvest; includes herbaceous plants in mostly whole plant form, and browse. For the purpose of this report, forages are considered to include both perennial and annual vegetation suitable for livestock use.

Grazing Management. The manipulation of animal grazing in pursuit of a defined objective.

Grazing System. A specialization of grazing management which defines the periods of grazing and non-grazing or rest.

Greenfeed. Annual forage harvested as whole crop while still green and baled as livestock feed. Commonly used crops in Saskatchewan include cereals (barley, oats, wheat, triticale), legumes (peas), and oilseeds (canola) or other types of annual crops damaged by climatic conditions rendering them unsuitable for normal harvest.

Haylage. Ensiled grass, grass legume or legume perennial forage. Generally lower in moisture content that silage. cf. 'Silage'.

Intensive Grazing Management. Grazing management that attempts to increase production or utilization per unit area or production per animal through a relative increase in stocking rates, stocking density, forage utilization, labour, resources, or capital. cf. extensive grazing management.

Introduced Species. A species not part of the original fauna or flora of the area in question. cf. native species.

Native Species. A species which is part of the original fauna or flora of the area in question. cf. introduced species.

Overgrazing. Occurs when a plant is grazed before it has completely recovered from a previous defoliation event; continued grazing which exceeds the recovery capacity of the plants causes range deterioration.

Paddock. A division of land within a grazing cell.

Pasture. (1) A grazing area separated from other areas by fencing or other barriers; the management unit for grazing land. (2) Forage plants used as food for grazing animals. (3) Any area devoted to the production of forage, native or introduced, and harvested by grazing.

Pastureland. Grazing lands, planted primarily to introduced or domesticated native forage species

Pedigreed Seed. Forage seed classification that meets two main criteria. The first criterion involves the production and inspection of the crop according to the Canadian Seed Growers' Association's Regulations and Procedures for Pedigreed Seed Production. The second criterion stipulates that cleaning and grading of the seed be carried out according to the *Canada Seeds Act* and *Regulations.* If the requirements have been met, a crop certificate is issued for the variety and class.

Private Seed. Seed lines developed, bred and owned by a private company.

Range. (n.) Land supporting native vegetation that either is grazed or that has the potential to be grazed, and is managed as a natural ecosystem, including grassland, forests, and shrubland. Range is not a use. (adj.) Modifies resources, products, activities, practices and phenomena pertaining to rangeland. cf. rangeland.

Rangeland. Rangelands, a broad category of land comprising more than 40% of the earth's land area, are characterized by native plant communities, which are often associated with grazing, and are managed by ecological, rather than agronomic methods. The term "range" can also include forestlands that have grazing resources, or seeded lands that are managed like rangeland. Range resources are not limited to the grazable forage, but may include wildlife, water and many other benefits.

Range Condition. The composition of range plant communities relative to the kinds and relative amounts of plants that range is naturally capable of supporting.

Range Improvement. Any activity or program designed to improve production of forage, change vegetation composition, control patterns of use, provide water, stabilize soil and water conditions, or provide habitat for livestock and wildlife.

Range Inventory. A list of resources of a management area, including ecosites, range condition and trend, degree of use, stocking rates, physical improvements and natural features.

Range Management. A distinct discipline founded on ecological principles and dealing with the use of rangelands and range resources for a variety of purposes. These purposes include use as watersheds, wildlife habitat, grazing by livestock, recreation and aesthetics, as well as other associated uses.

Reclamation. Restoration of a site or resource to a desired condition to achieve management objectives or stated goals.

Riparian Zone or Riparian Area. Referring to or relating to areas adjacent to water or influenced by free water associated with streams, rivers or water bodies.

Ruminant. A hoofed mammal that chews a cud and has a four-chambered stomach.

Silage. Fermented, high-moisture fodder that can be fed to ruminants. It is fermented and stored in a process called ensiling and usually made from annual crops, including cereals, corn or sorghum using the entire green plant (not just the grain). Silage can be made from many field crops (annual or perennial), and special terms may be used depending on type.

Sod Grass. Stoloniferous or rhizomatous grass which forms a sod or turf.

Stocking Density. The number of animals on a given area of land at any moment in time. For example, an acre of land grazing 50 cows for one day each year would have a stock density of 50 head per acre.

Stocking Rate. The number of animal units on a unit area of land for a specified time period. This is usually expressed in AUMs/acre or acres/AUM. For example, 160 acres of rangeland on which 10 cows graze for four months has a stocking rate of 0.25 AUMs/acre or 4 acres/AUM.

Swath Grazing. Annual crop harvested while still green (optimum stage depends on crop type) and left in the swath (windrow) for livestock to graze at a later date. Commonly used crops in Saskatchewan include cereals (barley, oats, triticale), legumes (peas) or other types of annual crops damaged by climatic conditions rendering them unsuitable for normal harvest.

Tame Species. See "Introduced species".

Watershed. A total area of land above a given point on a waterway that contributes run-off to the water flow at that point. A major subdivision of a drainage basin.

Yellowfeed. A method of harvesting forage where an annual cereal crop is sprayed with glyphosate at the milk-soft dough stage and allowed to stand until dry. During this process, a color change from green to yellow is normally noted. Once the crop has dried, it is cut and baled immediately after cutting. Yellowfeed is a viable alternative harvesting option when annual cereals are harvested for hay.

Notes:

Notes:

Project Partners

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