RURAL ECONOMY

Ecological Goods and Services Survey Summary
Prepared for: Lower Souris Watershed Committee

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Project Report #09-01

Project Report

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Acknowledgement: Alicia Entem analyzed the survey data and completed this report under the supervision of Jim Unterschultz and Scott Jeffrey. The data for the survey were collected by the Lower Souris Watershed Committee. Funding was provided by the Lower Souris River Watershed Committee project "Lower Souris Watershed Ecological Goods and Services Pilot Proposal" which is funded in part by Advancing Canadian Agriculture and Agri-Food (ACAAF) Program.

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Abstract

An interview based survey of farm landowners in the south east corner of Saskatchewan was undertaken to evaluate the provision of wildlife habitat by agriculture. Producers were asked to provide management information regarding a piece of their land that was managed as a unit. Within the past ten years there has been a reduction in the conversion of remaining native land to crop land, an increase in conversion of annual crop land to perennial cover crops, an increase in the use of minimum disturbance (no-till) farming, and a decrease in the use of fire on stubble fields and sloughs. Many producers in the area often stated economic reasons for their current land use division. Even ecological reasons (productive capacity of the soil, poor cropping soil, light soil etc.) often had an economic basis. If the land was not productive enough, a management scheme with lower input costs would be adopted. This was commonly demonstrated in this survey by the conversion of marginal land to tame forages. Producers within this region seem willing to adopt farming practices that connect economic sustainability with environmental responsibility. This survey is part of an-on going study of the region.

JEL Classification: Q150, Q240
Key words: Land Use, Tillage.

PREFACE: LOWER SOURIS ECOLOGICAL GOODS AND SERVICES SURVEY

The Lower Souris Watershed Committee contracted a private interviewer to survey local farmers within the Lower Souris River Watershed. The specific purpose of the interview was to collect information on the provision of wildlife habitat in many different farm settings. Rather than interviewing producers regarding their land practices on a farm-wide basis, producers were asked to provide management information regarding a piece of their land that is managed as a unit. The interview was designed to collect information on fields where wildlife habitat has been "lost", "maintained" or "enhanced" through farm activities. The survey was divided into three primary sections: identifying wildlife habitat and costs of conversion; identifying inputs, operations and production from cropping enterprise; and identifying inputs, operations and production from grazing and haying enterprise.

1 INTRODUCTION

1.1 The Lower Souris River Watershed

The Lower Souris River Watershed (LSRW) is located in the south-eastern corner of Saskatchewan. It is bound to the east by Manitoba and to the south by North Dakota (LSRW 2007). The LSRW encompasses 20 rural municipalities (12 totally, 8 partially), 19 urban municipalities, and three First Nation's lands (Saskatchewan Watershed Authority 2006).

The watershed is located within the Aspen Parkland Ecoregion. In this corner of the province, the Aspen Parkland Ecoregion receives 320 mm of precipitation during the growing season. Historically the landscape was a mosaic of fescue grasslands and aspen groves underlain by black chernozem and orthic grey luvisol soils respectively. Agriculture is the primary land use within the watershed and approximately 80% of the landscape is cropped (Saskatchewan Watershed Authority 2006). The remaining watershed area is divided between grasslands (10%), shrubland (4%), treed areas (3%) and marsh (2%).

The entire LSRW is encompassed within crop district 1A and 1B which in 2006 contained 1 823 and 1,743 farms respectively (Statistics Canada 2007). The total farm area within the 1A and 1B crop districts is 4,990,174 acres (Statistics Canada 2007) with an average farm size of 1,402 acres (Harper et al. 2008). Agricultural land is divided amongst annual crops, tame pasture and native land. Of the total farm area within crop district 1 (1A and 1B), 70% is annually cropped or left summerfallow, 10% is managed as tame pasture, and 15% is native land/pastures (native grasslands, aspen groves or riparian/wetland areas).

1.2 Description of Survey Participants

The results of this survey were compiled from a total of 87 interviews. The survey contains information from 87 distinct parcels of land. However, 25 farms within the survey were sampled twice (each time information was provided for a different unit of land). Thus, within the Lower Souris River Watershed, management information was acquired for 87 units of land from 62 individual farms making up 154,980 acres (about 3% of the farmland in crop district 1). The farms surveyed by the Lower Souris Watershed Committee – average of 2,626 acres – are larger on average than the entire population of farms within crop district 1 – 1 402 acres (Statistics Canada 2007). Within the survey, the 154,980 acres is broken down as shown in Figure 1. As compared to the entire crop district, the 62 farms sampled had a higher percentage of native land (24% vs. 15%) and tame forage land (19% vs. 10%) and a lower percentage of annual cropland (60% vs. 70%). On average, a farm would manage 1,616 acres of annual cropland.

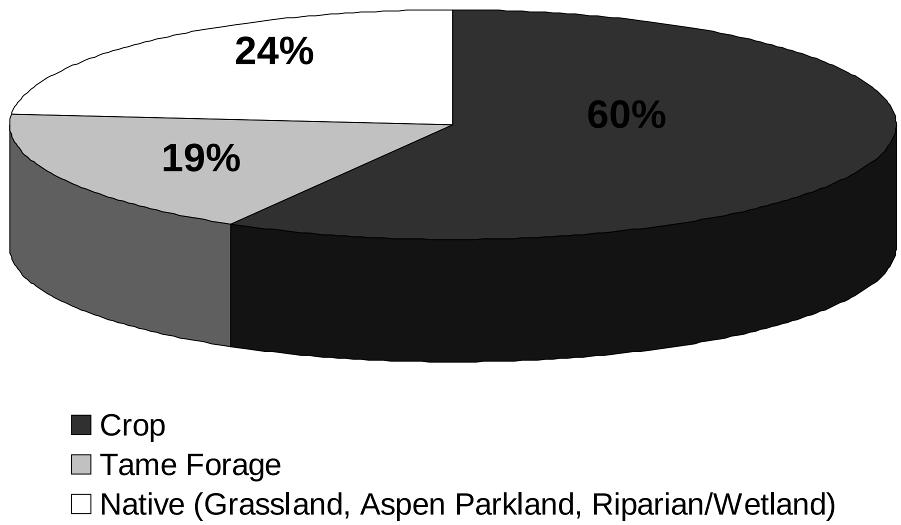

Figure 1. Percentage of farm area within survey (154 980 acres) that is managed as annual cropland, tame forage/pasture and native (grassland, parkland and riparian/wetland) land.

Forty of the 62 farms (65%) manage livestock. Amongst those 40 farms, the size of the livestock operation varied between 39 animals and 882 animals. On average, a farm producing livestock would own 8 bulls, 154 cows, 47 yearling, and 109 calves. The surveyed farms contained on average 483 acres of tame forage that could be used for haying, grazing or a combination of the two. The farms also averaged 640 acres of native land that could be used for livestock production.

2 IDENTIFYING WILDLIFE HABITAT AND THE COSTS OF LAND CONVERSION

2.1 Description of Surveyed Land Units

Within the 87 interviews, interviewees were asked to provide information regarding a piece of land that has been managed as a unit for the past 10 years. The first question required farmers to state the breakdown of acres between each land use/wildlife habitat category – annual cropland, tame forage, aspen parkland and riparian – on their unit of land. There was an additional category for "other" land use categories. The previous sections illustrated the breakdown of annual cropland, tame forage, and native land within the entire crop district and the entire acres of the surveyed farms; this section (Figure 2) shows the percentage of these land uses that currently make up the land that was included in further investigation within the survey. Compared to the entire crop district, the land units surveyed have a lower percentage of annual cropland (49% vs. 70%), and a higher percentage of both tame forage land (32% vs. 10%) and native land (27% vs. 15%).

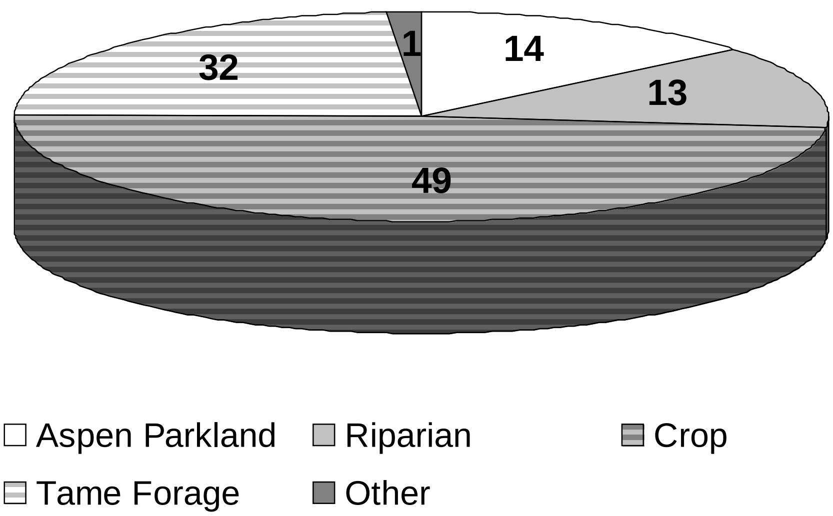

Figure 2. Percentage of all land within the 87 land units selected by respondents that is made up of Aspen Parkland, riparian areas, annual cropland, tame forage and other land uses.

The total area of land included within each of these 5 different land uses (or habitat types) from 1998 to 2008 is depicted in Figure 3. In 2008, there were 6,700 acres of annual cropland, 5,220 acres of tame forage land, 2,160 acres of Aspen Parkland, and 2,050 acres of riparian areas. The total area of land included within all 87 interviewee's responses was 16 341 acres in 2008, 16,175 acres in 2003 and 16,029 acres in 1998. The percent of the land base that each habitat type made up during the past decade is presented in Figure 4. On the 87 units of land surveyed, annual cropland made up the largest percent during 1998-2008. Tame forage occupied the second largest percentage of land, and Aspen Parkland and riparian areas were the third most common land uses (nearly identical percentages; Figure 4).

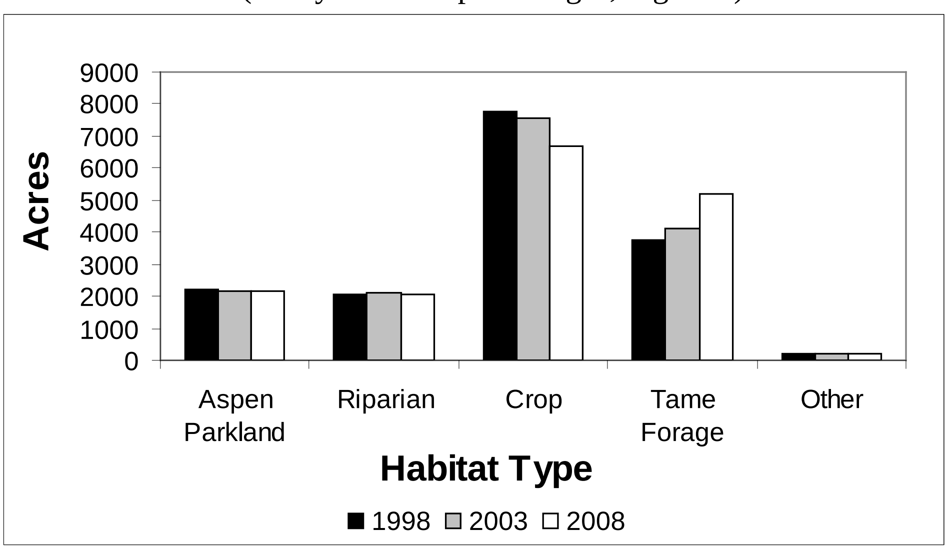

Figure 3. Total acres of surveyed land included within each habitat type for the 1998-2008 time period (n = 87).

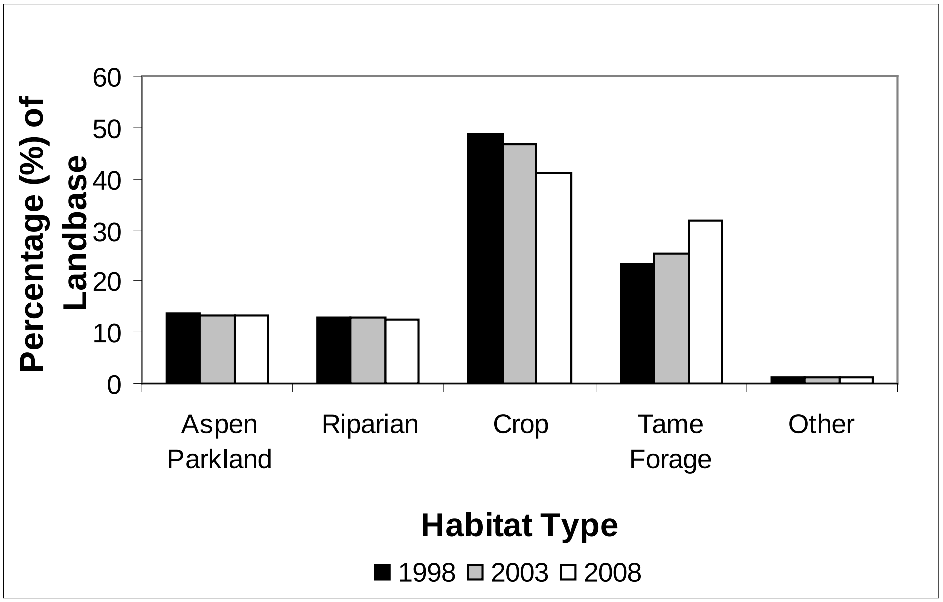

Figure 4. Percentage of surveyed land base in each habitat type during the 1998-2008 time period (n = 87).

2.1.1 Quality of Land for Agriculture and Wildlife

After the unit of farmland was divided into different land uses/habitat types, survey respondents were asked to classify the land by its quality for both wildlife habitat and agricultural usage. Farmer's were to state whether the land provided poor, fair, good or very good wildlife habitat and also whether the land was of poor, fair, good or very good agricultural quality. The resulting trends were that farmers believe Aspen Parkland and riparian areas are of poor to fair agricultural quality and provide good to very good wildlife habitat (Table 1). Farmers also believed that annual cropland and tame forage land is of good to very good agricultural quality. Annual cropland was believed to provide primarily fair to good wildlife habitat and tame forage land was believed to provide good to very good wildlife habitat.

Table 1. Acres of each surveyed land use/habitat type that provide very good, good, fair, poor or unknown quality for wildlife habitat and agricultural use.

	Wildlife Habitat Quality						
	Very Good	**Good**	**Fair**	**Poor**	**Unreported**	**Total Acres**	**N**
Tame Forage	1352	2923	740	60	145	5220	86
Annual Crop	1068	2462	2411	425	335	6701	84
Aspen Parkland	862.5	994	202	103	0	2161.5	86
Riparian	836.5	988	175	6	45	2050.5	83
	Agricultural Quality						
	Very Good	**Good**	**Fair**	**Poor**	**Unreported**	**Total Acres**	**N**
Annual Crop	3372	2754	240	0	335	6701	84
Tame Forage	1725	3143	352	0	0	5220	87
Aspen Parkland	209	645	502.5	805	0	2161.5	87
Riparian	49	830	595.5	570	6	2050.5	85

To assist comparisons between land uses (which is difficult due to differing acreages between land uses), the percentage of land falling into the various quality categories (very good, good, fair, poor) was calculated for each land use. There were zero acres of annual cropland reported by survey participants to be poor quality agricultural land (Figure 5a). Indeed, 91% of annual cropland was reported to be good or very good agricultural land. Seventy-three percent of annual cropland was recorded as fair to good wildlife habitat and the percent of annual cropland stated to be very good wildlife habitat (16%) more than doubled the amount stated to be poor habitat (6%). Farmers agreed that Aspen Parkland was high quality wildlife habitat (86%; Figure 5b), and while the majority of farmers believed Aspen Parkland was poor to fair (61%) quality agricultural land, there was still a large percentage considered as good agricultural land (30%).

Farmers surveyed within the LSRW appear to believe that the quality of tame forage land for both agricultural use and wildlife habitat are nearly equivalent with a slightly better performance as agricultural land (Figure 5c). Tame forage land was primarily stated to be good to very good wildlife habitat (82%) and agricultural land (93%). Eighty-nine percent of riparian land was considered good to very good wildlife habitat and no acres were considered poor wildlife habitat (Figure 5d). Farmers were split between whether they believed riparian areas were poor (28%), fair (29%), or good (40%) agricultural land; however, very few riparian acres were recorded as very good (2%) agricultural land.

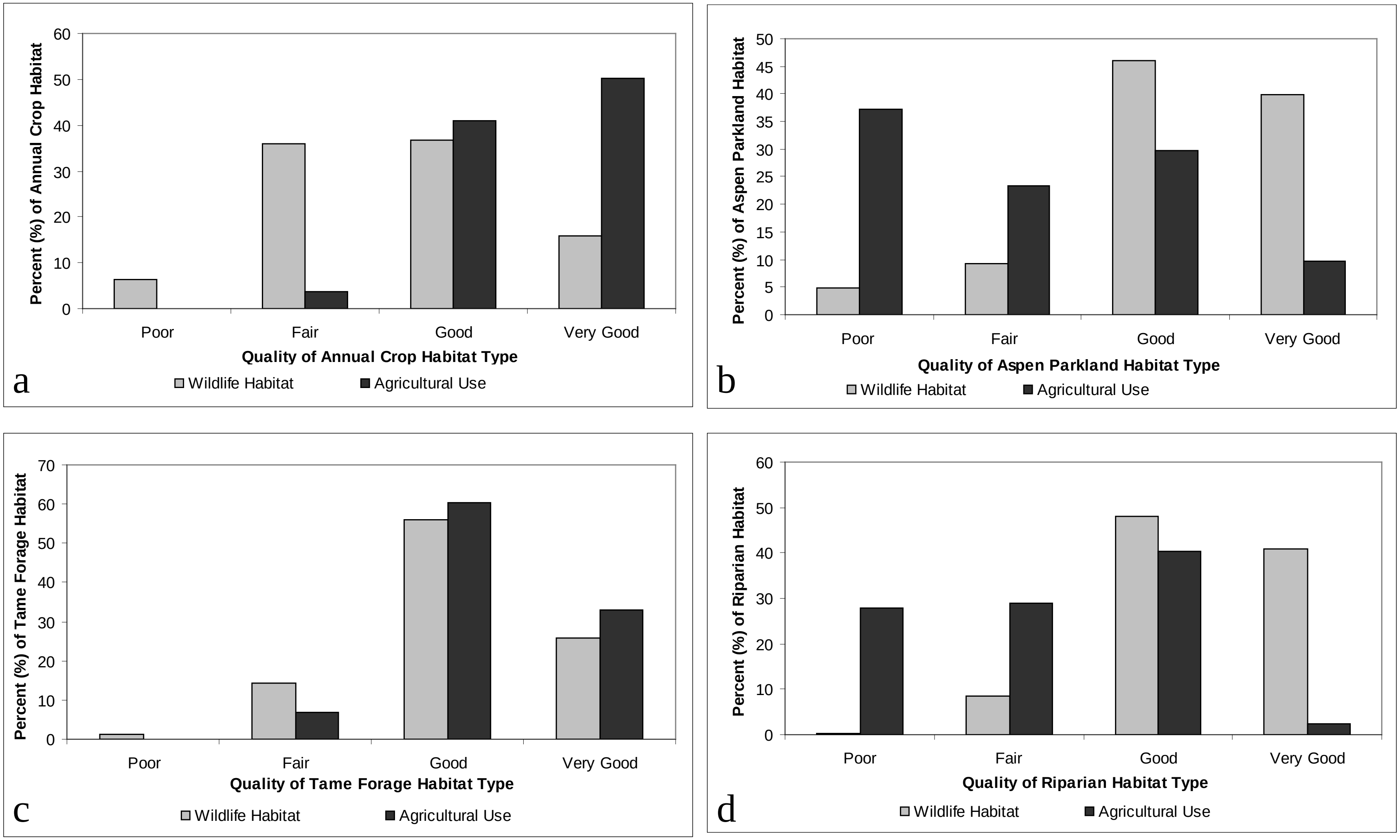

Figure 5. Percent of total land area within annual crops (a), Aspen Parkland (b), tame forage (c) and riparian areas (d) that are included within poor, fair, good, and very good quality categories for both wildlife habitat and agricultural usage. Table 1 provides information on the number of land units included within each category.

2.2 Land Conversions

As shown previously in Figures 3 and 4, there has been a noticeable increase in the area of land managed as tame forage and a decrease in the area of land managed as annual cropland. During the previous decade (1998-2008), 17 producers on 17 different farms and land units have converted land from one form to another. Examples of land conversion include clearing Aspen trees and planting tame forages, or draining riparian lowlands and seeding annual crops. Overall changes in acres of land within each land use/habitat type for the past decade (1998-2008), as well as changes in the first five years of the time period (1998-2003) and the last five years of the time period (2003-2008) are shown in Figure 6. A positive number of acres gained indicates a net increase in the acres of land in that habitat type; a negative number of acres denotes a net loss in the acres of that habitat type.

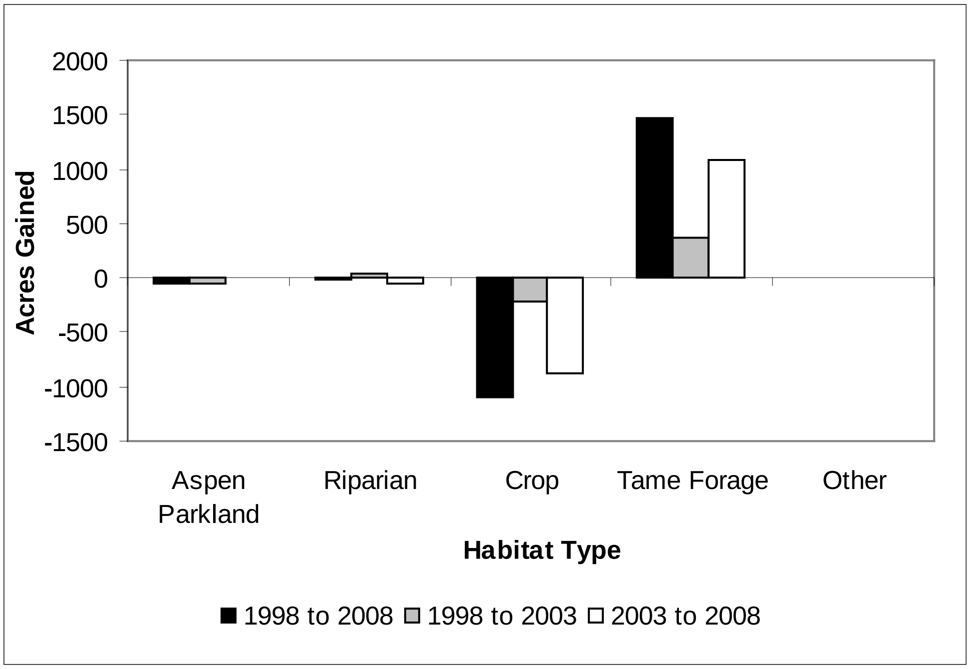

Figure 6. Land use changes between 1998 and 2008 shown in acres converted between habitat type (n = 17).

Between 1998 and 2003, there was 54 acres of Aspen Parkland lost (Figure 6). However, from 2003 to 2008, 10 acres of Aspen Parkland were restored which resulted in a total of 44 acres of Aspen Parkland being converted to alternate land uses during the ten year period. The overall loss of riparian areas during the ten year period was 21 acres. From 1998 to 2003, 35 acres of riparian areas were restored/created, but 56 acres were drained during 2003-2008. The overall loss in acres of annual cropland was 1089 acres. Most of the conversion of annual cropland occurred in the last 5 years (877 acres). During the same decade, the acreage seeded to tame forage increased by 1466 acres with the majority of these acres being converted during the past 5 years (1089 acres). The majority of land conversions on the surveyed farms were planting annual cropland to perennial forage (Figure 7).

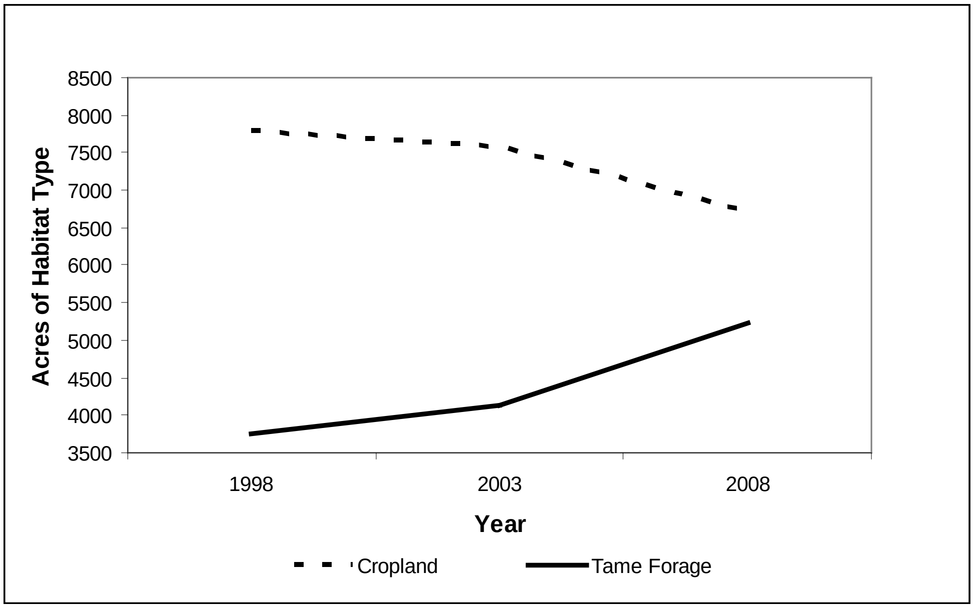

Figure 7. Landbase changes due to conversion from annual crops to perennial tame forage between 1998 and 2008 (n = 87).

2.2.1 Reasons for Converting Land

The primary conversion of land during the past 10 years has been from annually cropped lands to tame forage. Much of the conversion from annual crops to tame forage has been due to either the land's poorer productive capacity or poor past crop prices (Table 2). Much of the converted land was stated to have light soils and, therefore, poor crop production. Some producers stated that the decreased returns from annual cropping prompted them to either adopt livestock as a farm operation, or to increase their cattle herd. As a result, more land for haying/grazing was required. One producer mentioned that concern regarding soil and water erosion caused him to convert 63 acres of annually cropped land back to tame forage (60 acres) and riparian habitat (3 acres). Two producers stated that developments, a gravel pit and oil wells, prevented them from annually cropping land. Others stated that sloughs and bluffs made the area more suited to grass and livestock than to annual cropping. A farmer that maintained his native Aspen Parkland and riparian areas stated his reason as an extended spring and fall grazing season. Some stated convenience – over-wintering or calving pastures close to home, or expansion of rented pastures – as a reason.

Producers that have converted or maintained land as annual crops often state the high productivity of the land as a primary reason (Table 2). Other producers have gotten out of cattle and therefore no longer require hay/grazing land. Producers that have removed aspen bluffs and drained low lying riparian areas state reasons such as increasing their productive land base, saving time (estimated seeding time of 21 acres/hour without obstacles vs. 14 acres/hour with obstacles), and wasting less chemical and fertilizer (due to decreased overlap). One producer broke up his tame pasture because it was an old stand with low productivity.

Table 2. Reasons stated by producer's for their current allocation (due to land conversions during or prior to the last ten years) of land amongst Aspen Parkland, riparian, annual crop, and tame Forage habitat types (n = 28).

	Number of Producers Stating Reason as Their Choice			
Reasons for Land Allocation	**First choice**	**Second Choice**	**Third Choice**	**Total Number**
Economics	7	4	6	17
Land's Productive/Ecologic Capacity	7	4	2	13
Hay/Grazing Land Needed	5	8	3	16
Productivity of Cropland	5	0	0	5
Time Saving	2	2	0	4
No Livestock	1	2	0	3
Livestock Preference	1	0	0	1
Convenience of Management	0	1	2	3
Increase Crop Area	0	1	1	2
Lower Risk with Tame Forage	0	0	1	1
Senescence of Tame Grassland	0	0	1	1

2.2.2 Steps for Converting Land

In the conversion of land from crops to tame forage, the average time until the land can be used by the farm is 12-14 months. The longest recorded times to utilization occurred in two cases; one farmer experienced slow establishment and another left the field fallow for a year. The steps carried out during conversion of annual cropland to tame forages often include a fall and/or spring cultivation, spraying with glyphosate (application rate of 1 L/acre to 1.5 L/acre), rock picking, seeding a cover crop (often Oats) and either a grass mix or an alfalfa grass mix (eg. 10% alfalfa, meadow brome/crested wheat grass mix), and land rolling following seeding. A couple of operations were required to perimeter and cross fence pastures and dig dugouts following land conversion.

When converting Aspen Parkland or riparian areas to cropland, equipment rentals often made up the bulk of the time and money expenditures for the land conversion. Tree removal was done using a cat or a bulldozer. The trees are piled and burned and the land is sprayed with glyphosate to kill vegetation and a heavy duty breaking disc is used to till the land. The time taken to clean up the land so that it could be utilized ranged from 2 to 5 years. The drainage ditches used to clean up riparian and low lying areas are dug by track hoes, cats, and scrapers. The time required for converted riparian areas to be utilized in production was only 12 months.

Converting tame forage land to cropland requires a couple more steps than the reverse process; however, it is still relatively inexpensive as compared to converting riparian or Aspen Parkland areas to cropland. A double glyphosate application (fall and spring) is often used to kill the perennial forages. In required cases, land leveling occurred and fertilizer was applied (often fertilizer is fall or spring banded). Cultivation and seeding of the annual crop often occurs the spring after the last hay crop was harvested. The land is immediately in production and providing revenue within a year.

2.2.3 Costs of Converting Land

Some producers provided specific costs incurred or land treatments required during land conversions (Table 3). Conversion costs for converting 4 acres of Aspen Parkland and 64 acres of riparian area to cropland will be used as an example of calculating conversion costs. In this instance, clearing the area may require 50 hours of cat work ($8,000), a glyphosate application ($612), and 40 hours of heavy duty discing ($2,000) for a total cost of conversion equaling $10,612.

Table 3. Equipment/materials required to carry out land conversions and the associated costs.

Equipment/Materials	Unit Cost
Dugout	$1.05/m^3
Cat rental (moving slash)	$160/hour
Cat rental (land leveling)	$48/acre
HD Disc rental	$50/hour
Track Hoe and Scraper	$100/hour
Bulldozer	$78/acre
Ditching	
Glyphosate	$9/acre (1L/acre) $14/acre (2L/acre)
Fertilizer Mix: (40 lbs/acre N; 25 lbs/acre P; 5 lbs/acre K)	$30/acre
NH_3 fall banding	$21/acre (70lbs/acre)
Perimeter Fencing	$500/mile

Costs of converting land were estimated using the survey information provided and cost information collected from a variety of sources. Producers provided information on steps taken to convert land and equipment/materials used. This information was paired up with crop prices, equipment prices and material prices in publications by the Saskatchewan Government as well as other market sources accessed online. The prices included in the calculation of land conversion costs were operations directly related to establishing the land conversion. As such, dugouts and perimeter fencing were excluded from the cost of converting cropland to tame forage. Also, the costs and revenue of harvesting cover crops were excluded from calculations; however, seed and seeding costs were included for cover crops since they assist tame forage establishment.

Specific rental or cost information was included when provided; however, when prices were unspecified the estimation of conversion costs resulted from a standardized methodology. An $8.50/acre cost for a custom glyphosate application (Government of Saskatchewan 2007) was used for all producers using a pre-seeding glyphosate application. One producer used another herbicide, and the cost of application was calculated by determining the application rate, the cost of the herbicide and adding a $0.95/acre fee for custom pesticide application (Government of Saskatchewan 2008a). The 2008-2009 Farm Machinery Custom and Rental Rate Guide published by the Government of Saskatchewan (2008a) was used to determine machinery costs. The costs of the particular equipment as well as a tractor (if necessary) were included. A speed of 4.5 miles/hour was used to convert area covered per hour into an equipment size. Prices were always chosen from the highlighted row in the equipment's category. Labour costs were not included in machinery costs. Cover crop prices were calculated by halving the prices per acre provided in the 2008 Black Soil Zone Crop Planning Guide (Government of Saskatchewan 2008c). Forage seed prices were based on information provided by the Dryland Forage Production Guide (Saskatchewan Government 2007) for the black soil zone. A smooth brome (4lbs/acre; $2.30/lb) – alfalfa (5lbs/acre; $1.80/acre) mix was used as a price guide. As a result, forage seed was calculated at $18.20/acre for all producers. Fertilizer prices were either provided by producers or based on information received during December 2008 from the Swift Current Co-op Agronomy Centre located in southwestern Saskatchewan.

A typical survey response would be as follows: a producer would supply the information that on his/her 110 acres he/she applied glyphosate (1L/acre), used a HD cultivator (10 hours), picked rocks (4 hours), seeded a cover crop of oats with an air seeder (11 hours), broadcasted a forage seed mix with a harrow bar and valmar (8 hours), and used a land roller (8 hours). Then the costs were determined from the previously mentioned sources. The costs would be tallied as: $8.50/acre for a 1L/acre custom glyphosate application, $44.11/hr for a 20-ft HD cultivator with tractor, $32.51/hr for a rock picker, $124.43/hr for an air seeder and tractor, $6.93/acre for oats cover crop seed, $111.10/hr for harrow bar and tractor, $12.86/hr for valmar, $18.20/acre for forage seed, and $85.71/hr for a land roller and tractor. The total cost would be $7316.53 and the unit cost would be $66.51/acre. The average calculated costs of converting land are displayed in Table 4.

Table 4. Per acre cost of converting land between land uses/habitat types.

Land Conversion	Unit Cost ($/acre) Mean (Std. Error)	N
Crop to Tame	61.37 (4.71)	13
Native to Crop	202.85 (70.32)	3
Tame to Crop	91.5	1

3 IDENTIFYING INPUTS, OPERATIONS AND PRODUCTION FROM CROPPING ENTERPRISE

Currently, 51 of the 87 units of land contain at least one annually cropped area. For 3 of these land units (165 acres), no additional information is provided. However, two units of land (total of 185 acres) were converted from annual crops to tame forage during the 2003-2007 time period. For these two land units, cropping information was provided until the time of conversion. Thus, data on cropping systems in the LSRW come from 48 land units in 2007 (6536 acres), 49 land units in 2006 (6621 acres), and 50 land units from 2005-2003 (6721 acres). All the land units for which cropping information was provided came from 46 of the 62 producers surveyed. The average acres of cropland per unit of land are included in Table 5.

Table 5. Acres of land currently used as annual cropland (n = 51).

Acres of Cropland per Land Unit				
Minimum	Mean (Std Error)	Maximum	Median	Total Acres
40	131 (6.9)	320	130	6701

3.1 Cropping Information

3.1.1 Crops Seeded

The annual crops most commonly grown in the surveyed area are canola, wheat (Hard Red Spring Wheat, Canadian Western Red Spring Wheat, Hard White Spring Wheat, Canada Prairie Spring White Wheat, Winter Wheat), barley, oats, and flax (Figure 8). Winter wheat makes up only about 11.2 % (CI_{95} = 7.1, 16.3) of the total acres planted to wheat. On average, 384 acres (or 6%) of the annually cropped acres is summerfallowed. Peas, rye, yellow mustard, millet and sunflower make up a minor proportion of the seeded area (Figure 8).

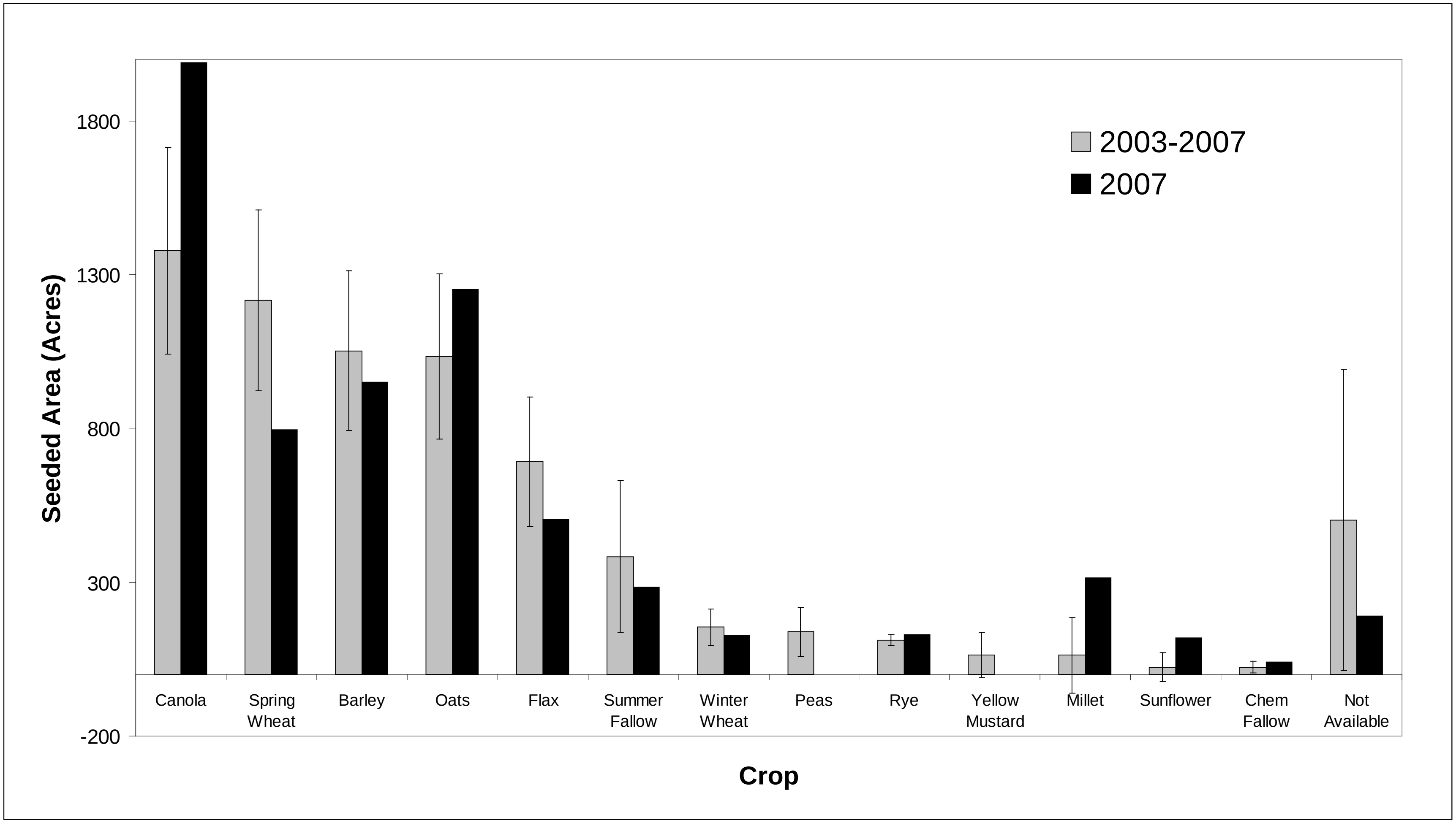

Figure 8. Average (2003-2007; n = 50) and total (2007; n = 48) acres left fallow or seeded to each reported crop. Not available category includes all acres for which crops were not reported. Error bars show 95% confidence intervals for the 5 year average.

In Figure 8 it appears that canola had a greater seeded acreage in 2007 than the five year average would suggest it should and spring wheat has a lower seeded acreage in 2007 than its five year average would have suggested. While these overall trends appear in the data, the high variability in the acres seeded to canola and wheat from year to year and between units of land, inhibits statistical differences from being found between yearly seeded acres. There is continual variation in the seeded acres of all the major crops in the area (Figure 9).

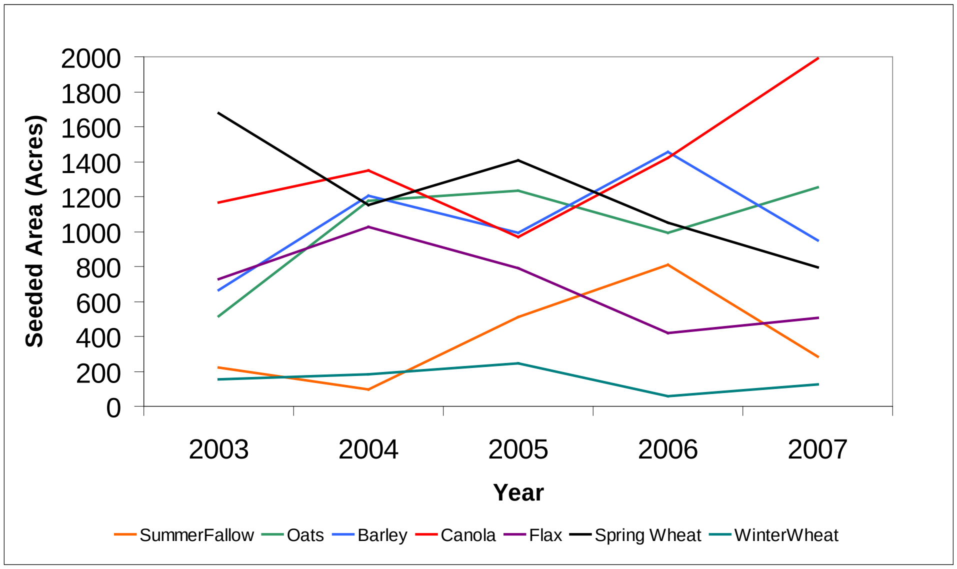

Figure 9. Acres left summerfallow and seeded to all major crops (2003-2007; n = 50).

3.1.2 Seeding Equipment

The three seeders primarily used by producers within the LSRW are air drills, air seeders and hoe drills. Air drills and air seeders are more commonly used by producers and seed more acres than hoe drills (Figure 11 and 12). The increased prevalence of no-till farming has had an impact on the seeding equipment farmers use. The result is that most farmers now use air seeders/drills.

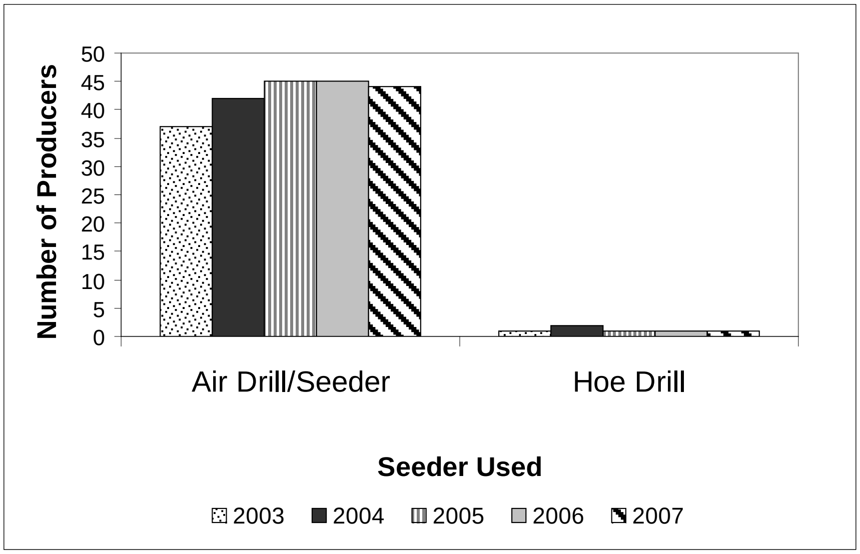

Figure 10. Seeding equipment used in cropping enterprise by producers in the LSRW (n = 46).

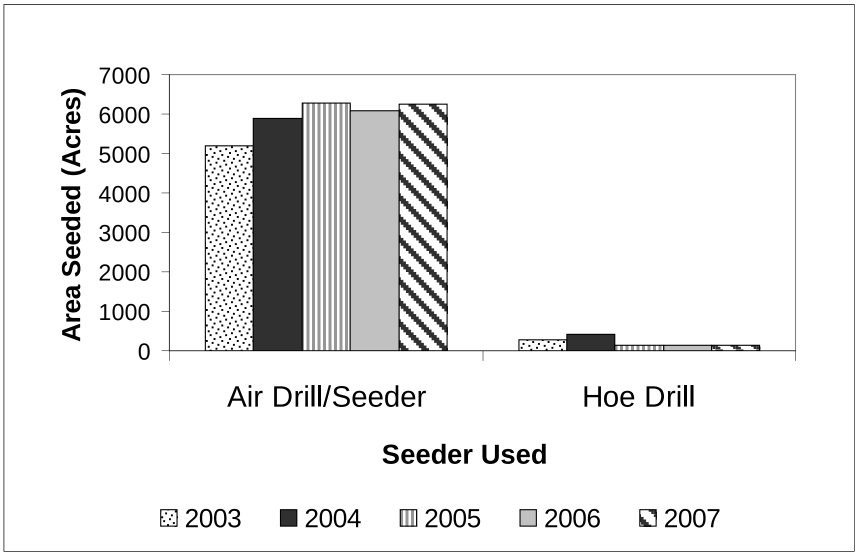

Figure 11. Acres seeded by each seeder (2003-2007; n = 46).

3.1.3 Crop Yield

All the yield data for each crop grown during the 2003-2007 period were averaged across all land units and all producers to determine the averages displayed in Figure 13. Yields were calculated in bushels per acre and resulted in oats providing the highest yield at 68 bushels per acre. Barley followed at 59 bushels per acre, then wheat with 37 bushels per acre, canola with 27 bushels per acre and flax with 19 bushels per acre. These yields closely followed the yields reported during the 2003-2005 period by Statistics Canada (2007); however, the yields reported in the 2006 census were consistently a couple of bushels per acre lower than the yields calculated as a result of this survey.

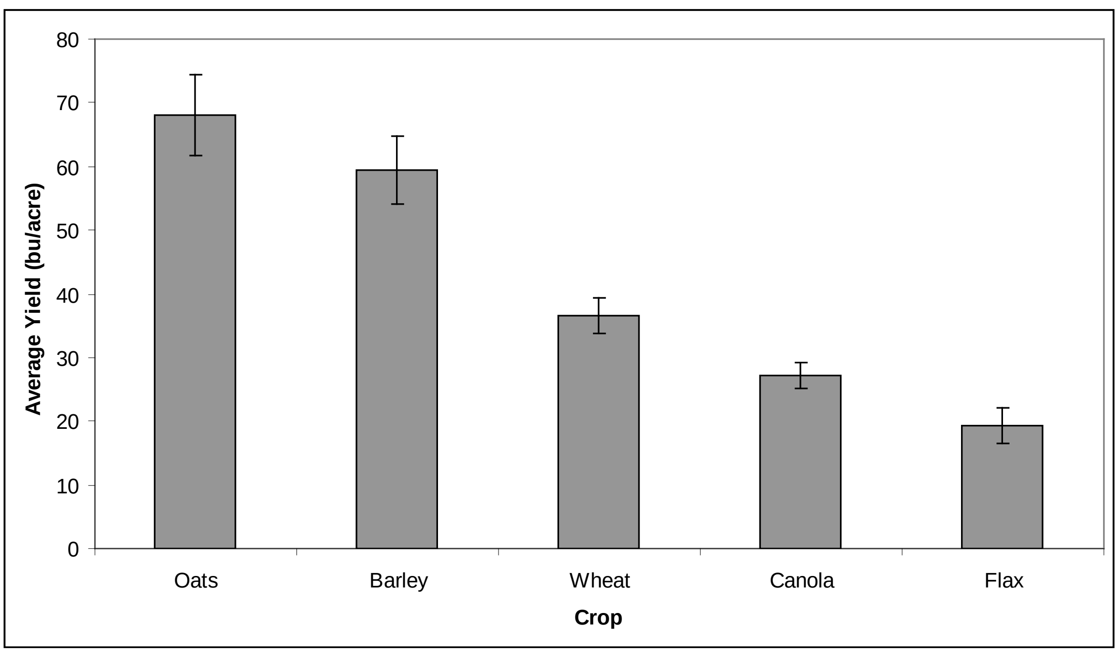

Figure 12. Average yield for each crop within the LSRW during the 2003-2007 cropping period (Oats, n = 38; Barley, n = 44; Wheat, n = 46; Canola, n = 58; Flax, n = 35).

3.1.4 Crop Quality

The producers interviewed grow their crops for a variety of different purposes. The data provided does not provide information on the final destination of the crop (on farm feed, future seed, sale). However, some farmers provided enough information within the interview to indicate that during the 2003-2007 period, some of the oats was grown for green feed or as additional grazing land for their cattle. More commonly, farmers would grow barley, wheat and oats as feed for their cattle. There were also times when a farmer would indicate that the purpose of the oats or barley grown was to provide cover to their newly seeded perennial forage.

Within the canola crops, the quality categories are Canada #1 and Canada #2. On average, far more acres are harvested as Canada #1 Canola (1333 acres/year) than Canada #2 Canola (24 acres/year). In fact, during the 5 years of data provided, the only canola that was graded as Canada #2 was 120 acres in 2006. Flax and wheat are two other crops that are primarily graded as #1 on the land surveyed (Table 6). 2004 was a poor year for wheat with over half the acres graded as #3 wheat or used as feed. Barley is often classified as feed barley (sold as feed grade barley, or used as on-farm feed).

Table 6 provides information on the acres of land grown to each crop's quality class. Unreported quality and unaccounted for quality classes result in some percentages not summing to 100.

Table 6. Percentage of canola, wheat, flax, barley and oats acres that make up the crop quality classes (n = 48).

		Percent of Total Acres Grown				
Crop	**Quality Class**	**2003**	**2004**	**2005**	**2006**	**2007**
Canola	# 1 Canada	99	91	90	91	100
	# 2 Canada	0	9	0	0	0
Wheat	#1 HRSW/CWRS/Wheat	87	23	70	73	92
	#2 HRSW/CWRS/Wheat	8	7	25	12	0
Flax	# 1	91	87	92	100	87
Barley	Malt	15	35	10	33	59
	Feed	85	65	90	67	41
Oats	#1 CW	0	12	0	0	0
	#2 CW	62	71	40	65	49
	#3 CW	0	0	19	0	20
	#4 CW	0	3	5	0	13

3.1.5 Crop Inputs

Inputs accounted for in this survey included fertilizer and pesticides (herbicides, insecticides and fungicides). The information was provided for each year (2003-2007) and determined on a per crop basis.

3.1.5.1 Fertilizer Applications

The two elements surveyed specifically were Nitrogen (N) and Phosphorous (P), but some farmers provided additional information on their Potassium (K) and Sulphur (S) applications. It was believed that the crop seeded would have a great impact on fertilizer requirements and that a time trend was unlikely. Thus, fertilizer was broken down on a per crop basis. While this provides part of the picture, the fertilizer needs of a field is also likely based upon the combination of crops that were grown previous to the current year's crop. When N and P application (Lbs/Acre) were calculated per crop it was clear that canola, mustard, wheat, and flax crops often receive higher N and P inputs than crops such as oats, rye, millet and sunflower (Figure 14). Peas receive low nitrogen inputs (likely due to legume's symbiotic relationship with nitrogen fixing bacteria) and high phosphorous inputs (Figure 14).

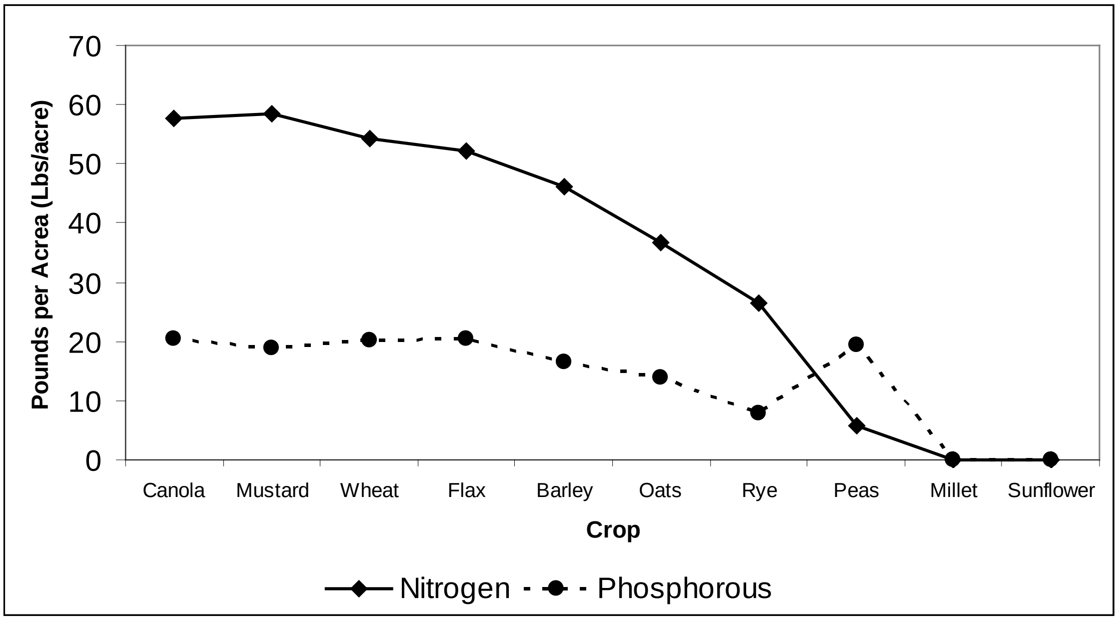

Figure 13. Average nitrogen and phosphorous application rate from 2003 to 2007 (n =48).

Potassium (K) and Sulphur (S) application rates were also provided by producers. Overall, K and S are applied at a lower rate than N and P (Figure 15). Canola, mustard and peas appear to be the crops with the highest sulphur requirements while the highest potassium application goes to barley, peas, wheat and canola (Figure 15).

Considering N, P, K and S applications, canola, mustard, wheat, and peas appear to have the highest supplemental nutrient requirements. Rye, millet and sunflower seem to be the crops with the lowest supplemental nutrient requirements.

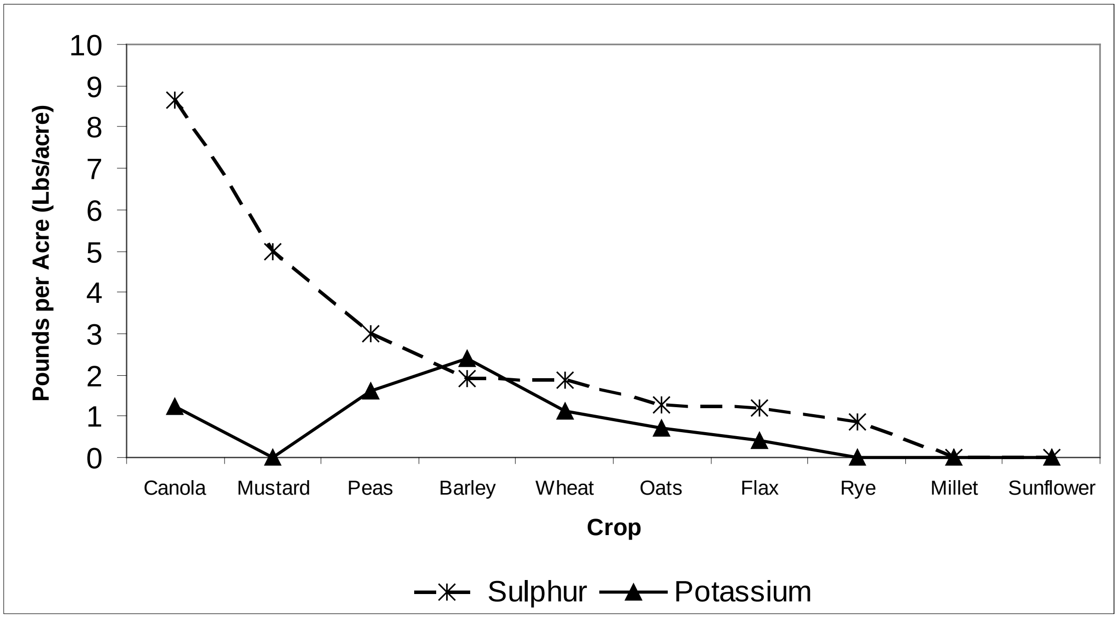

Figure 14. Average application of sulphur and potassium to each crop during the 2003-2007 period.

3.1.5.2 Pesticide Application

Similar to the fertilizer applications, the number of pesticide applications was matched to the crop being grown (Figure 16); however, the application was not average over 2003-2007, but instead was only provided for 2007. For example, on average, a spring wheat crop would have had just over 4 pesticide applications during 2007. This could include a pre-seeding glyphosate treatment, in crop herbicide treatments, in crop fungicides and/or insecticides and a pre-harvest glyphosate application. Error bars illustrate the 95% confidence interval for the mean number of pesticide applications per crop. For some crops (eg. millet, sunflower), there were not enough replications to provide confidence intervals, and thus the intervals were not reported.

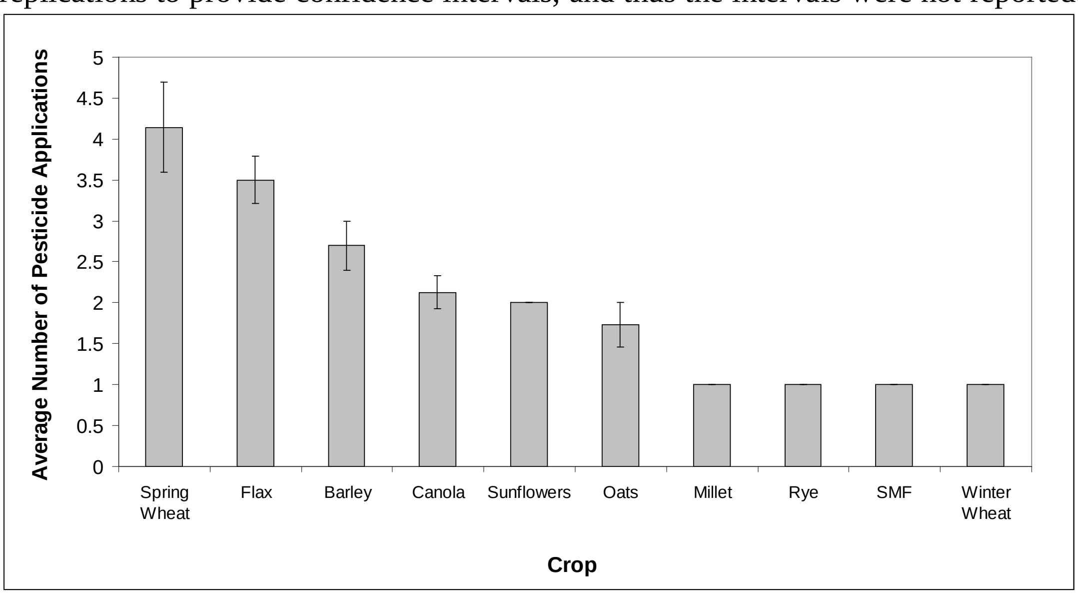

Figure 15. Average number of pesticide applications per crop during the 2007 growing season.

Pesticide use was determined for each producer on their surveyed unit of land. For the four producers that provided information on two units of land, an average of the number of chemicals applied over both areas was taken to determine the producer's pesticide application. There was no difference in the number of chemicals used/number of applications producers used throughout the years of 2003-2007 ($F_{4,214} = 1.11$; $p = 0.355$). The average number of pesticide application was not significantly different between years as shown by the overlapping confidence intervals in Table 7. The lower total number of applications in the earlier year was due to non-reporting (37 farmers vs. 46) of chemical prescriptions by farmers, likely due to the dependence on recalling such information 5 years after the fact. There was a trend of increasing pesticide use between 2006 and 2007 despite having the same number of respondents. This may be due in part to real differences, (that nonetheless remain insignificant) or, the trend may also be due to recall bias. Farmers may be able to remember all the chemicals they used the previous year, but may miss some chemicals when they are asked to recall 2 years prior.

Table 7. Producers' pesticide use during 2003-2007.

	Pesticide Applications				
Year	2003	2004	2005	2006	2007
Total	89	98	99	100	120
Per Producer	2.4	2.2	2.2	2.2	2.6
95% CI	(2.0,2.8)	(1.9,2.5)	(1.8,2.6)	(1.8,2.5)	(2.2,3.0)
Number of Producers	37	45	45	46	46

With regards to the timing of pesticide application, over 90% of the applications take place during the spring. Some fungicides or insecticides may be applied during the late spring/early summer. Pre-harvest spraying with glyphosate (Vantage Plus, Roundup etc.) can be used on peas, wheat, barley and flax. Pre-harvest dessication spraying (1L/acre) and post-harvest weed kill (0.5L/acre) are the only spraying that occurs during the fall. Spraying is often primarily done with self-propelled high clearance sprayers (Figure 17). A few producers stated they used self-propelled sprayers but did not specify as to whether or not they were high clearance. The second most common sprayer is simply a tank and hose system that is pulled behind a tractor. Aerial application was not commonly cited as an application method.

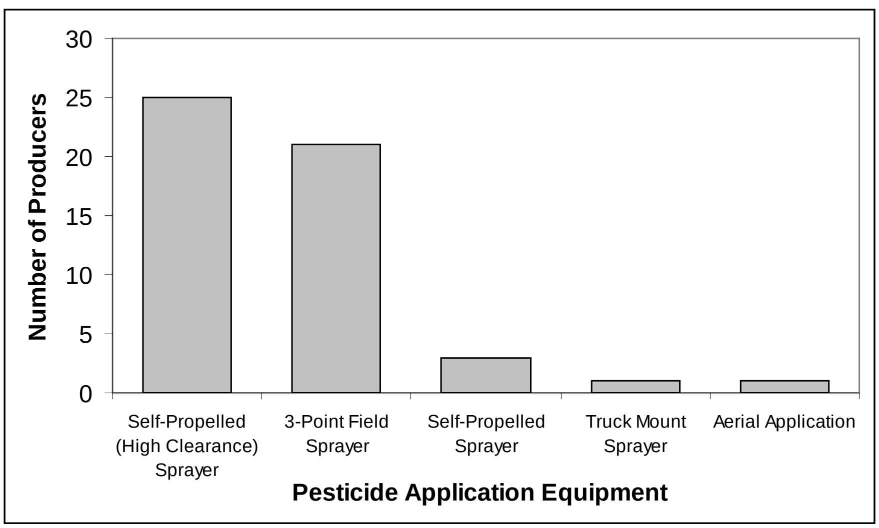

Figure 16. Pesticide application equipment used during the 2007 growing season (n = 51).

3.1.6 *Other Cropping Practices to Improve Land for Wildlife*

Producers were asked if they have any cropping practices that improve habitat for wildlife. The two main responses were minimal disturbance cropping (no-till) and the reduction or elimination of burning. Of those producers who stated a method through which they improved the quality of their cropland for wildlife, the majority stated that they have converted to no till, continuous cropping. Some even mentioned that they have also begun to increase the stubble heights left on field to increase wildlife cover. Another very common practice is to eliminate the practice of burning crop residues, sloughs and riparian areas. Two producers stated that they have introduced shelterbelts, and another has constructed a dugout which his cattle (and wildlife) use in the fall when grazing the crop residue. One farmer revealed that he avoids using pre-seeding herbicides, and another farmer stated that he has seeded winter wheat into standing stubble to increase wildlife cover.

4 IDENTIFYING INPUTS, OPERATIONS AND PRODUCTION FROM GRAZING AND HAYING ENTERPRISE

Information on pasture/hay land was provided by 46 producers regarding 52 land units (6 producers answered regarding 2 units of land each). Two producers provided no additional information on their livestock/hay operations although their land units contained tame forage, aspen parkland and riparian areas. Due to land conversions taking place during the period of 2003-2007, some producers may have provided less than the full five years of data requested. As a result, some years have information from less than 52 land units.

4.1 Grazing Land

Thirty-nine producers answered questions regarding livestock operations. Five of these producers answered for two units of land; thus, the information provided in this section covers 44 units of land.

4.1.1 *Livestock Type and Size*

Cow-calf pairs are by far the most common livestock managed on the grazing land surveyed. On average, 87% of the land units within the survey were grazed by cow-calf pairs. Yearlings, heifers and horses make up a very small percentage of the livestock grazed in the area. Table 8 includes the average size information for livestock within the surveyed area. Within the table, the animals were converted in a standardized grazing unit called an animal unit. One animal unit is equivalent to a 1000 lb cow with an un-weaned calf or without a calf. There was only one producer for both the horse and cow livestock category.

Table 8. Size of livestock within surveyed land units and number (N) of producers for each livestock category (2003-2007).

	Animal Size (Lbs)				
Type of Livestock	Minimum	Mean	Maximum	AU Equivalent	N
Cow	1400	1400	1400	1.29	1
Cow-Calf Pair	1200	1294	1600	1.21	38
Horses	1200	1200	1200	1.15	1
Yearling	800	860	925	0.89	3
Heifer	700	750	800	0.81	2

4.1.2 Grazing Systems

Grazing systems and philosophies vary greatly across producers. However, there are some generalizations that can be made for the entire surveyed area. The growing season starts in the middle to end of May and finishes around the end of September to middle of October. Most grazing systems reflect this with a total of around 120-160 days of grazing.

The grazing systems implemented by farmers in the region include season long, complementary, rotational, and high intensity low frequency (HILF) grazing. Season long grazing and some method of rotational grazing appear to be the most common grazing systems. HILF grazing was only done by a couple of producers.

Complementary grazing involves the use of each vegetation type when it is most palatable and nutritious for livestock. In this case, farmers use tame grass in the spring when they are most palatable and use native fescue and aspen area for fall grazing when native grasses are the most palatable. Rotational grazing can also be included within a complementary grazing system. For example, a producer would graze tame grass in the spring and rotate throughout tame pastures. Later in the season, tame pastures would be re-entered to graze the palatable re-growth. Then, in the fall, the cattle have native forage to graze on that is highly nutritious and has not yet been grazed. It was difficult with the information provided to discern which producers were using complementary grazing, but some stated that having native areas extended their spring and fall grazing period. However, it was clear that 20 out of 44 (45%) producers used rotational grazing.

Season long grazing is a system that involves a farmer allowing livestock to graze the same area for the entire season. This can be damaging to pastures because palatable species are constantly selected and unplatable (possibly weedy or invasive) species are able to thrive due to a competitive advantage. However, season long grazing results in high animal gains and require minimal time inputs. Season long grazing, occurring on 17 out of 44 (39%) land units, was the second most common grazing practice.

High intensity, low frequency (HILF) grazing systems are utilized by two producers (5%) in the LSRW. This grazing system is a labour intensive rotational system that requires temporary cross-fencing to create small paddocks that are grazed at a high intensity (70%+ utilization) and then the cattle are not returned to the same area for a long time which gives the vegetation a significant rest period (Holechek et al. 2004). It is believed by some to benefit grassland vegetation which would thereby benefit both cattle and wildlife (Keenan 2000).

Five producers (11%) grazed crop residues (aftermath grazing) on their land unit. The crop residues grazed included barley and oats and grazing typically occurred for between 10 and 15 days. There were also trends in the data suggesting that producers prefer to winter their cattle in pastures with aspen groves. The aspen provide a natural windbreak from the cold winter winds.

4.1.3 Stocking Rate

For producers that provided sufficient information (number of grazing days, area grazed, size of livestock and number of livestock), animal unit months per acre (AUM/acre; Stocking Rate) were calculated which demonstrates the number of 1000 lb cows or cow-calf pairs that could be grazed on each acre for a month. Knowledge of the stocking rate can provide information on whether the area is overgrazed; overgrazing can detrimentally affect the rangeland and wildlife that rely on it. The stocking rate can also provide information on the productivity of the land. Within the dataset, the five year average stocking rate is 0.89 AUM/acre

(CI_{95} = 0.81, 0.97). This is equivalent to 1.12 acres/AUM which means that it would take 1.12 acres of pasture land to provide enough food for a 1000 lb cow to graze for a month. The recommended stocking rates for pastures depend on the condition of the pasture and whether the pasture is tame or native.

According to the Government of Alberta (1998) website, within the 350-450 mm annual precipitation zone, the acceptable stocking rate for tame pastures is 1.25 AUM/acre for excellent condition pastures, 0.80 AUM/acre for good condition, and 0.6 AUM/acre for fair condition pastures. These statistics are for pastures that are continuously grazed with minimal fertilizer inputs. If a producer is using rotational grazing and a fertilizer program, they can increase their grazing capacity and stocking rate.

As a whole, it does not appear that the stocking rate used (0.89 AUM/acre) is unsustainable. However, individual farmers within the area vary widely in their stocking rates. For example, one producer maintained a stocking rate of 2.4 AUM/acre over 3 years while continuous grazing his land and another producer never stocks his land unit higher than 0.2 AUM/acre during the fall. It is important to note the limitations of the data provided. Information was not always provided on what areas of land were hayed, which were grazed and whether grazing occurred after haying. Thus, calculations of forage utilization are crude.

4.1.4 Supplemental Feeding

Limited information was provided on supplemental feeding. Only 2 producers provided the information that they creep feed their calves. Creep feeding is used to assist in weaning calves from their mothers. They are fed high nutritional feed just prior to being weaned in order to prevent weight loss. These producers said that they creep feed their calves rolled oats for 30 days.

4.1.5 Range Improvements and Associated Costs

Range improvements conducted by landowners include cross-fencing (electric, barbed wire), dugouts, water pipes/trenches, stock waterers, portable windbreaks, bush mowing, and fertilizing (manure/urea). Cross-fencing was done using 4-strand barbed wire ($2600-3600/mile) and 2-strand electric fences. One farmer used solar powered electric fencing. Dugouts ranged in price from $500-3000 with an average of $1800/dugout. Portable windbreaks were priced at $500/30’ windbreak. Water pipeline (0.75 miles) and a watering bowl cost one farmer $2200. Producers used a tractor and HD rotary mower, a GyroMower, and a Bulldozer ($78/hr) to mow bush and remove hawthorns from their land. Drainage to keep water on an area took 2.5 days with a scraper ($100/hr).

Range management actions that assist wildlife on the landowners’ properties include Ducks Unlimited Canada (DUC) projects, hunting control, and flushing bars. One farmer seeded a 0.5 mile water runway (61’ wide; total of 8 acres) to grass as part of a DUC project, another farmer pointed out that he posts “No Hunting/Hunting with Permission Only” signs up around his land. Another landowner uses a flushing bar when haying. Flushing bars are chains that hang in front of the blades of haying equipment. The chains scare out animals (especially nesting ducks that are otherwise hesitant to move and leave their nests) preventing the animals’ injury/death. Dugouts and watering bowls assist wildlife by providing watering sources during the winter.

4.2 Haying Land

Haying information was provided by 31 producers. Only one producer provided information for two units of land. Therefore, 32 units of land were used to determine haying characteristics in the LSRW.

4.2.1 Hay Production

Bale production throughout 2003-2007 ranged from 1.84 bales/acre in 2003 to 2.19 bales/acre in 2007. The highest forage production was found to be 6880 lbs/acre and the lowest forage production was stated at 1050 lbs/acre. Hay production information is summarized in Table 9. Overall it appears that productivity was low in 2003 with both smaller bales and fewer bales per acre. There is an overall positive trend in productivity over the 2003-2007 period (Figure 18).

Table 9. Information on hay production (yield, size, productivity) from 2003-2007.

	Tame Forage Production				
	2003	**2004**	**2005**	**2006**	**2007**
Yield (Bales/acre)	1.8	2.0	2.1	2.1	2.2
Size (Lbs/bale)	1218.8	1301.9	1340.4	1335.2	1316.1
Productivity (Lbs/acre)	2560.0	2597.2	2771.2	2741.1	2840.5

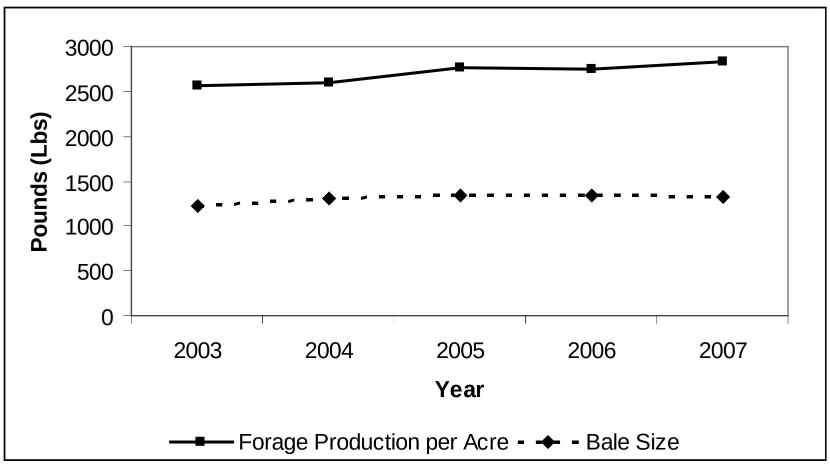

Figure 17. Average forage production (lbs/acre) and bale size (lbs) for the 2003-2007 period.

4.2.2 Haying Equipment

Farmers within the LSRW all use similar haying equipment. Mower conditioners, swathers (self-propelled and tractor pulled) and crimpers are used to cut the hay. Mower conditioners are the more common choice (Figure 19). Only one farmer mentioned the rake used in the haying operation – in this case a v-rake. Other farmers may have overlooked mentioning their raking equipment. Round baling is the most common baling method; no producers mentioned any square bale production on their land units. Only one producer utilized the services of a custom baler on their land.

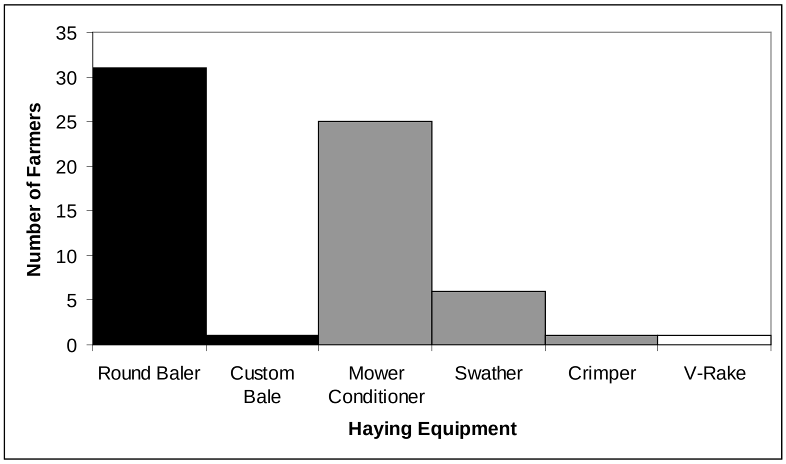

Figure 18. Haying equipment (black = baling, grey = cutting, white = raking) used by producers (n = 32).

4.2.3 Haying Inputs

Very few farmers reported applying fertilizers to their hay land, and no producers reported applying pesticides to their hay land. One producer reported that he applied Potassium (K) application to his hay lands at a rate of 20-30 lbs/acre. Three producers reported applying Phosphorous (P) to their lands at an average rate of 45.5 lbs/acre. Eleven producers stated that they applied Nitrogen (N) to their hay lands and the average application rate was 63.4 lbs/acre. Most farmers applied nitrogen only 1 or 2 years out of 5, and only 3 farmers applied it 3 or more times in 5 years.

Several producers (n = 9) reported applying manure to their pastures; however, none recalled the rate at which the manure was applied. A few other producers (n = 4) stated that cattle are overwintered on their pasture land which provides nutrients through the application of feces and urine during the winter.

5 SUMMARY

The rich black soils of the LSRW make the area prime agricultural land, and it must be understood that agricultural land and wildlife habitat are not separate and mutually exclusive entities. However, farming practices have varying effects on species. Some species benefit, and others are hindered. Thus, it should be made clear the wildlife that habitat is to be provided for. While stubble fields may be optimal foraging grounds for white tail deer, they may offer little in the way of subsistence for other species. The information regarding the quality of each land type (tame forage, crop etc.) for wildlife habitat is therefore subjective and based upon each producer's perception and knowledge of both what is wildlife and the habitat requirements for those wildlife species.

The information provided within this survey gives a coarse look at what is happening on agricultural land within the LSRW. With respect to the provision of wildlife habitat, both positives and negatives became evident as a result of the survey. Positives include the minimal conversion of remaining native land, the increase in perennial cover crops, the prevalence of minimum disturbance (no-till) farming, the decreased use of fire on stubble fields and sloughs, the use of rotational grazing, the presence of DUC projects on the land, and the use of flushing bars while haying. Negatives include the large amount of native land that has already been converted, the prevalence of pesticide use, and the common use of season-long grazing.

The surveyed producers answered questions about land parcels that had more native and tame pasture/hay land and less annual crop land than the entire crop district. Many producers in the area often stated economic reasons for their current land use division. Even ecological reasons (productive capacity of the soil, poor cropping soil, light soil etc.) often had an economic basis. If the land was not productive enough, a management scheme with lower input costs would be adopted. This was commonly demonstrated in this survey by the conversion of marginal land to tame forages. Even no-till farming provides both ecological and economic benefits. Producers within the LSRW seem willing to adopt farming practices that connect economic sustainability with environmental responsibility.

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7 APPENDIX 1. PESTICIDES USED, RATES APPLIED, AND ASSOCIATED COSTS

Pesticide	Rate Applied	Cost	Pesticide	Rate Applied	Cost
2,4-D	0.45L/acre		Glyphosate (Vantage Plus, RoundUp, Weather Max)	0.5L/acre or 1L/acre	
Achieve	0.2L/acre		Horizon	0.095L/acre	$22.00/acre
Achieve Liquid Gold	0.8L/acre		Liberty	1.1L/acre	
Adrenaline SC	0.4L/acre		Lorsban (Insecticide)	0.405L/acre	
Assert	0.54L/acre		MCPA Amine 500	0.5L/acre	
Attain	0.5L/acre		MCPA Ester	0.45L/acre	
Broadleaf Herbicide			Oddyssey	17g/acre	
Buctril M	0.4L/acre	$13.29/acre	Pardner	0.4L/acre	
Centurion	0.0355L/acre		Pre-Pass	0.5L/acre	$6.39/acre
Chloropyrifos (insecticide)		$5.14/acre	Prestige		
Cleanstart			Puma	0.25L/acre	
Curtail	0.61L/acre		Pyrinex (Insecticide)	0.405L/acre	
Decis (insecticide)	0.04L/acre	$3.23/acre	Refine	12g/acre	
Dicloroprop			Refine M	12.5g/acre	
Edge	7kg/acre		Refine SG	12g/acre	
Everest	11.5L/acre		Select	0.0255L/acre	
Estaprop	0.71L/acre		Stratego (fungicide)	0.2L/acre	$12.00/acre
FlaxMax	1L/acre		Target	0.4L/acre	
Folicur (Fungicide)	0.118L/acre	$9.40/acre	Tilt (Fungicide)	0.2L/acre	
Fortress			Puma + Buctril M		$15/acre
Frontline	0.32L/acre	$7.50/acre	Select + Buctril M		$13.29/acre
Frontline XL	0.506L/acre		Vantage Plus (Glyphosate 1L/acre)		$10.14/acre
Furaden (insecticide)			Everest + Attain		$22.62/acre
Fusion					

Note: Pesticides are often applied as tank mixes of 1 or more product which makes determining costs (and sometimes application rates) difficult.

Additional Costs:

High clearance custom spraying costs $4.50/hour
The Terms of Use Agreement with Monsanto for Roundup Ready Canola is $15/acre; Weather Max (glyphosate) then costs $3.90/acre

8 APPENDIX 2. LSRW EXPERT INTERVIEW GUIDE

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Lower Souris Ecological Goods and Services Pilot Proposal: On-Farm Economic Component

Expert Interview Guide

Objectives: The expert interview is to guide the Lower Souris Watershed Committee private contractor in the collection of information related to the different on-farm scenarios regarding the ecological goods and service (EG&S) of wildlife habitat. Whole farm cost and returns data are not required however this study will examine individual enterprise budgets for an identified land location to determine local average agricultural costs of production. Aerial photos of the entire region allowing exact mapping of locations and areas will be available from 2005 and another set of photos are to be taken in 2007 as part of this study. The specific objectives of the expert interview are to gather data on the provision of wildlife habitat in many different farm settings. This expert interview is to collect information on fields where wildlife habitat has been "lost", "maintained" or "enhanced" through farm activities. Since there are too many scenarios to define ahead of time, the approach will be an expert interview with the interviewer writing down specific answers.

Land locations ______________________

Step1: Identify wildlife habitat and costs of conversion

On a particular piece of land managed as a unit what are the current acres of habitat and how much was there 5 and 10 years ago?

Habitat type	Currently	Five years ago	Ten Year
Aspen Parkland / Native Range			
Riparian			
Cropland			
Tame forage			
Other			

Identify current "quality" of the EG&S. Would the interviewee rate the quality of the land in agricultural use and in EG&S for wildlife usage as very good, good, fair or poor.
Agricultural Usage (Value of Farm Income)

Aspen Parkland / Native Range acres : very good, good, fair or poor
Riparian Acres: very good, good, fair or poor
Tame Forage Acres: very good, good, fair or poor

Wildlife habitat

Aspen parkland / Native Range acres : very good, good, fair or poor
Riparian Acres: very good, good, fair or poor
Tame forage Acres: very good, good, fair or poor

Identify and rank the top four reasons for converting these areas identified above to annual crops, tame pasture or hay (1 being most important reason)(identify which areas or scenarios this applies to;

1.
2.
3.
4..

What were the steps required to convert the land to annual crops, pasture or hay, how long did each activity take

How many months or years to reach the point at which annual cropping, haying or pasture could be utilized by the farm)

What is the interviewee's rough estimate the operations and inputs required for each step (e.g. machine hours for clearing, fencing, water development).

Step 2: Identify Inputs, operations and production from cropping enterprise

	Cropping	**2007**	**2006**	**2005**	**2004**	**2003**
Crop	Crop Rotation (crop type):					
	What type of drill used to seed?:					
	Estimate of yield (i.e. to calculated nutrients removed from land)?					
	Estimate of yield quality (to calculate nutrient removal)?					
Fertilizer	What is the rate of fertilizer application? N					
	P					
	Other:					
	Other:					
Chemical Inputs	What pesticides/herbicides do you use?					
	What are the application rates?					
	What time of year are they applied?					
	How are they applied?					

Step 3: Identify Inputs, operations and production from grazing and haying enterprise

		2007	2006	2005	2004	2003
Grazing	Type of livestock grazed					
	Average size of animal					
	Number of days of grazing					
	When (dates) that grazing occurs					
	Number of days of feeding/supplementing					
Haying	Number of bales/acre					
	Average bale size					
	Operations used to put up hay					
Inputs Identify if it applies to hayed or grazed acres	Rate of N fertilizer application					
	Rate of P fertilizer application					
	Pesticide application					

Identify other investments/costs to improve riparian or range health (watering systems, fencing, windbreaks)

Step 4: Wrap up the Interview

Interviewer to ask:

What is the total farm size in acres in 2007? (owned and rented)

How many acres in annual crops in 2007?

How many acres in tame pasture and hay in 2007?

If appropriate ask for the total estimate of native range / aspen parklands and wetlands that are on the entire property.

What were the total number of livestock (e.g. Number of cows, backgrounders, yearlings, and bulls on May 1 2007)

Interviewer to request if the Lower Souris Watershed Committee Ltd. employees can enter the specific land discussed in the above interview and take physical EG&S measurements. If the answer is yes then present another consent form for access to land.

Exchange thank you.

End of interview.