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Rapid Assessment Case Study:

The Environmental Information Infrastructure of Pulse Production in Canada

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November 2009

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1.0 Introduction

This case study assesses the information infrastructure being used to portray the environmental implications of lentil production in Canada. It was prepared to complement the report Linking Farm-Level Measurement Systems to Environmental Sustainability Outcomes: Challenges and Ways Forward (Russillo & Pintér, 2009). That report aims to help define and design tools and models to improve existing measurement systems that link farm-level to landscape- and regional-level environmental impacts by exploring the issues and the information infrastructure required to share and understand those links. This case study illustrates the construction and use of a measurement system in Canada related to the rise of sustainable agricultural practices that include conservation tillage and pulse production. The assessment includes the innovations, challenges and constraints related to this transformation. It also examines the common metrics and information infrastructure related to the rise of conservation tillage and pulse production, as well as the usefulness and gaps therein. Finally, it assesses the cross-scale interactions among different levels of assessment, from the farm to the federal level. This case study was selected because the environmental issues that gave rise to pulse production are well articulated. Environmental benefits and impacts from pulse production are also well-known and monitored by various organizations. In addition, the bulk of the crop is grown in a geographically well-defined area in Canada's Prairie region.

1.1 Lentil production in the global, regional and Canadian contexts

Agriculture is an important economic activity in Canada. In 2006 farming and the agri-food system contributed 8% of the nation's GDP, provided one of every eight jobs, and employed nearly 2.1 million people (Agriculture and Agri-Food Canada [AAFC], 2007).

After India, Canada is the world's second-largest producer of pulses—the edible seeds of legumes such as dry peas, beans and chickpeas—and it is the top exporter of lentils. Over the past three years Canadian farmers grew and exported 750,000 to 850,000 tonnes of lentils, accounting for 12.4% of global production and 47.6% of the world's lentil exports. Canada's lentil production tripled from 1991 to 2002, and today the crop is grown widely in the southern areas of Saskatchewan (Goodwin, 2003). Since Saskatchewan produces almost all of Canada's lentils, unless stated otherwise the information about Canadian lentil production in this case study refers to that province.

Figure 1 Canada's lentil-growing region (in green).

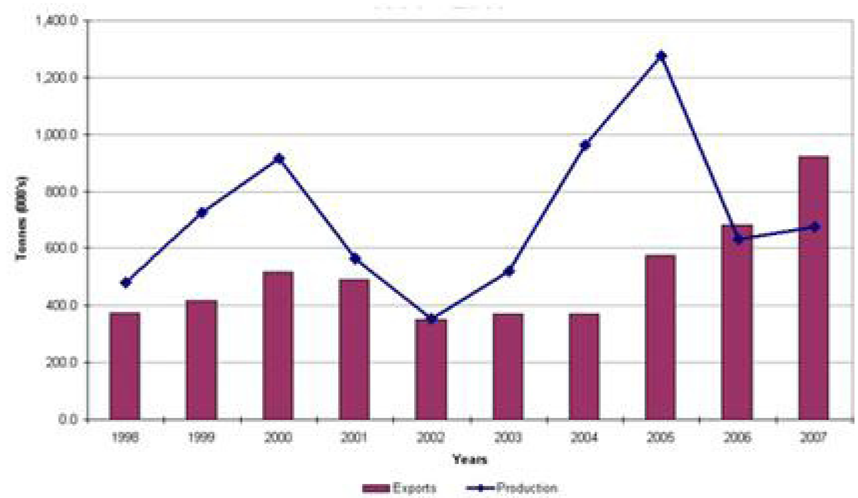
Source: Reprinted from Pulse Canada (2009).

Canada's commercial lentil production began with the planting of some 600 hectares of lentils on the prairies in 1970 (Saskatchewan Agriculture and Food, 2006). The crop grows best in the brown and dark-brown soil zones. Today about 97% of Canada's lentils are grown in these zones in Saskatchewan, which contains 41% of Canada's arable land (Figure 1); Alberta and Manitoba produce the rest (AAFC, 2000; Goodwin, 2003; Government of Saskatchewan, 2008).

In addition to its soils, Saskatchewan's climate is well-suited to lentil production. Lentil plants are somewhat tolerant of drought and light frost, but not of flooding or salinity. They require at least 150 to 250 millimetres of moisture during the growing season (Saskatchewan Pulse Growers, n.d.).

The increase in Canadian lentil production and exports has been driven by a number of factors, including improved market opportunities, advances in plant breeding, and new technologies that enhance production and harvesting techniques. The amount of land devoted to lentils has risen substantially since the mid-1990s as farmers have replaced the practice of summer fallow with planting of pulses such as lentils. This conversion has helped increase Canada's lentil production from 343,000 tonnes in 1991 to a record high of 1,307,000 tonnes in 2009[1]. The area seeded to lentils increased almost fourfold over that time.

Figure 2 Canada's lentil exports and production.



Source: Reprinted from AAFC (2009d).

Between 1996 and 2000 Canada's lentil exports increased in volume by 150% and in value by approximately 70%, from $171 million to $289 million. All of Canada's lentils are grown for human consumption. About 60% of Canada's total lentil exports go to 10 importing countries, sold on the open market to dealers ranging from large corporations to small family businesses. Some 40 dealers in the Prairie provinces purchase and clean lentils and ship them to market. Pulse Canada, a national organization of producers, processors and exporters, oversees market development (AAFC, 2000).

Canada produces five to six classes of lentils for market (IPM Centers, 2003). In 2007 the first herbicide-tolerant lentil varieties were made commercially available in Canada. Canada also grows a substantial amount of organic lentils, mostly green and French varieties. Production of organic lentils has increased substantially in the last decade, but still accounts for only 2% of the harvest (Canadian Organic Growers, 2005). The United States and the European Union import most of Canada's organic lentils (Ferguson, Weseen & Storey, 2005).

1 Data for 1991 from Canada Grains Council (2001); data for 2009 from AAFC (2009b).

1.2 The main environmental issues related to lentil-growing in Canada

Since the prairies' native grasslands were first cultivated, their soils have degraded substantially due to the expansion of agriculture, intensive tillage, monocultures and the extensive use of summer fallowing. These practices led to erosion and the loss of organic matter and nutrients, as well as to salinization (Gan et al., 2002; Kissinger & Rees, 2009). In recent years, prairie farmers have been changing management approaches to improve the sustainability of their land-use practices.

Legumes are unique among plants in their ability to partner with certain soil bacteria to take nitrogen, an essential plant nutrient, from the air and turn it into a form that can be used by plants. Lentils use water and nutrients efficiently, and their ability to fix nitrogen allows farmers to reduce reliance on synthetic nitrogen during the year the crop is grown. As well, the crop allows cereal producers to better manage cereal diseases and insects by widening the diversity of crops used in over the course of a number of growing seasons (Faye, 2007). Land in summer fallow declined by 25% as farmers progressively put arable land into continuous production. This trend toward continuous cropping and more lentil production was aided by improved seeding and tillage methods, as well as by the availability of more cost-effective, targeted herbicides (Statistics Canada, 2008). Summer fallow has been a controversial practice in the past. It has been practiced to increase the water available for succeeding crops in drier regions, but the practice can lead to more soil erosion and salinity problems. Thus, any system that minimizes summer fallow is positive from a soil-stewardship point of view.

There is now considerable evidence that reducing fallow and extending and diversifying crop rotations to include pulses such as lentils are having a positive impact on the semi-arid agricultural ecosystems in this region (Zentner et al., 2001; Johnston, Clayton & Miller, 2007). Benefits such as increased resiliency of agricultural soils, less dependence on chemicals and fertilizers and, as one farmer put it, "the principle of it, of feeding the soil" are seen as attractive environmental outcomes of pulse production.

By including nitrogen-fixing pulses such as lentils in crop rotations, farmers need less nitrogen from chemical fertilizers that can create environmental problems such as surface and groundwater pollution and emissions of nitrous oxide, a greenhouse gas. Reducing dependence on synthetic fertilizers is a net positive, since synthetic nitrogen is produced using an energy-intensive process that requires large amounts of non-renewable fossil fuel (natural gas). Reducing nitrogen-fertilizer use also reduces emissions related to its production and application, including greenhouse gases (Johnston et al., 2007). In addition, pulses increase the presence of bacteria that promote plant growth by enhancing disease resistance or balancing growth regulators. In this way, pulses can halt disease cycles (Faye, 2007). Finally, when cereal crops are planted after pulses, crop yields (and protein levels) usually increase, due in part to the fact that pulses disrupt the cycles of cereal pests (IPM Centers, 2003).

Pulse production also carries some potential environment risks; namely, the reliance on pesticides, herbicides and fungicides to control pests and disease. One of the major drivers of the change to no-till and pulse production was the reduction in the price of chemical crop-protection products such as glyphosate (originally sold as Roundup) (G. Patterson, Saskatchewan Pulse Growers, personal communication, July 17, 2009). With a source of cheap herbicides, farmers could readily experiment with seeding lentils in no-till systems without fear of losing their crops, replacing mechanical tillage for weed control, which in turn reduced erosion, slowed the breakdown of organic matter and conserved soil moisture. This was important because lentils and other pulses do not compete well with weeds.

The crops establish slowly, and in the seedling stages lentils have little vegetative growth. When lentils are seeded into stubble, as in no-till methods, seed from the previous crops can germinate, grow and out-compete lentils. While growers attempt to manage weeds using integrated, non-chemical methods, herbicides remain a cornerstone of production. Recently lentil varieties tolerant to imidazolinone herbicides became available in Canada (Saskatchewan Pulse Growers, n.d).

Fungicides are often used to control lentil diseases, which are an even bigger problem than weeds for Canadian lentil growers. Anthracnose can affect 40% of the area planted, and *Ascochyta* blight 60% to 70%, depending on weather conditions. Other diseases are *Botrytis* grey mould, root rot and *Sclerotinia* stem rot (Goodwin, 2003). Alternatives to fungicides exist, however. Lentil farmers can control some diseases by using a four-year crop rotation system that gives time for lentil residues that host disease to decompose and by avoiding planting next to the previous year's lentil crop (Saskatchewan Agriculture and Food, 2006). Seed-borne diseases are controlled by using disease-free seeds or by treating seeds. Proper seed treatments can also minimize soil-borne diseases such as root rot (Goodwin, 2003). In-crop fungicide treatments are used to prevent and treat some diseases. Of late, breakthroughs in breeding have drastically reduced spraying for some foliar diseases. Nonetheless, some fungicide use is necessary annually on some lentil acreage.

Some concerns have arisen about a greater risk of erosion with pulses compared to traditional cereals, because pulses (as well as oilseed crops) leave less crop residue to protect the soil over the winter. As well, lentil residue disintegrates more readily with tillage than do cereal residues. Erosion potential appears high when non-cereal crops are grown in brown and dark-brown soil zones, due to these regions' relatively low yields and the general presence of strong winds (Government of Saskatchewan, 2008).

As with any conventional crop production system, the reliance on crop-protection products, including pesticides, fungicides and herbicides, is a major concern when growing pulses. Overall, pulses are considered average in terms of chemical-use impact compared with other crops grown in Canada, such as wheat or potatoes, though Canadian crops use fewer chemicals generally, given the low survival of pests and diseases through Canada's cold winters. Lentil producers are active participants in the federal government's Reduced Risk program, which commits the industry to developing and using reduced-risk pesticides and pest management techniques such as biological controls, genetics and better management tools to aid farmers with timing and selection.

2.0 The environmental information infrastructure related to lentil production in Canada

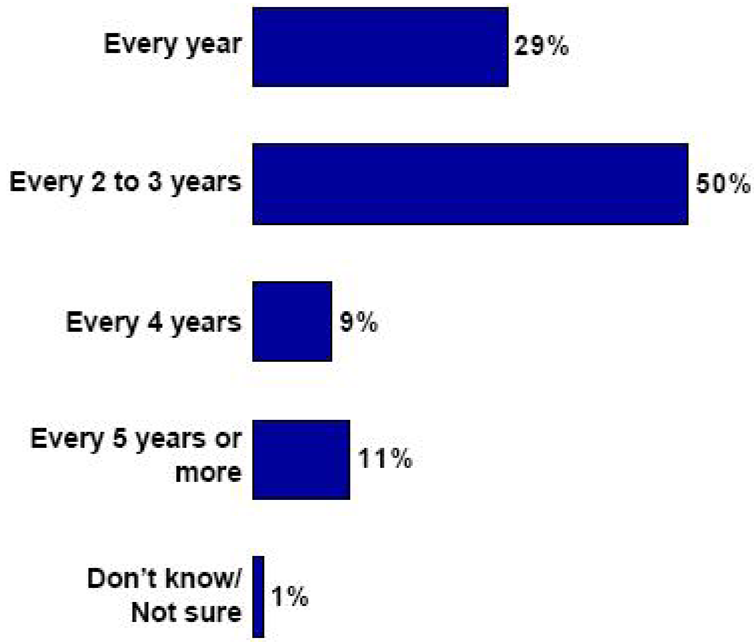
This section illustrates key metrics associated with pulse production and conservation tillage. We also outline the main drivers of the transition to conservation tillage and pulse production, as well as the players involved in the information infrastructure, the barriers and constraints, and the interactions between different levels of monitoring and assessment.

Three common pieces of information that are used to describe the environmental impacts and benefits of pulse-crop rotation in a minimum-till, continual-cropping system are soil fertility, soil loss and wheat protein content. These metrics use a combination of informal and formal monitoring techniques, with formal measurement usually employed at higher scales (provincial or federal) and in cases where negative impacts have been detected.

Soil organic content and soil moisture are two key metrics of soil fertility. Both relate to the availability of nitrogen, which is especially important in the brown and dark-brown soil zones, where nitrogen is the limiting factor in fertility. Soil organic content is positively related to soil porosity. A higher organic content contributes to better soil structure, which is measured at the farm level by producers, looking at infiltration indicators such as mellowness (reduced soil density), draft (force needed to till the soil) and rainfall pooling. Farmers generate this information, but unless it is more formally monitored, it is usually just used by the farmer and possibly passed on informally to peers. However, if soil structure indicators reveal poor infiltration and low organic content, the farmer may commission a soil fertility test. Soil moisture is also measured informally in this fashion, with soil testing commissioned when issues arise and farmers must change their farming practices. Thus, a secondary metric related to soil fertility is the frequency of soil fertility testing (see Figure 3). This data is generated by private firms that offer soil-testing services to producers for profit. However, due to the proprietary nature of this data, it is not widely disseminated. Agriculture and Agri-Food Canada (AAFC) also monitors the use and frequency of soil nutrient testing and disseminates this information publicly. This information is reported to the provincial level in the Ag-Environmental Indicator Report Series (Lefebvre, Eilers & Chunn, 2005).

When farmers in the brown and dark-brown soil regions monitor the risks related to growing pulse crops, they often look at soil loss through wind, water and tillage erosion as a metric that will guide their decisions regarding future pulse production. Farmers often "eyeball" soil loss informally until they notice changes that may require more formal assessment. For example, if the cropping system has allowed too much wind erosion to occur, farmers will reassess their choices. Often this means reducing the amount of tillage—especially with pulse crops, which leave less plant residue than grains, and so do not hold the soil in place as well. This information is not aggregated to higher levels for broader assessments. Instead, broader assessments rely on modelling to report on risks of soil loss. For example, AAFC generates soil-loss data in the form of a soil-loss rate, which is calculated for each of water, wind and tillage erosion risks. This data is sourced from the findings of the Census of Agriculture, linked to the Canadian Soil Information System's Soil Landscape of Canada polygons, as estimates of the change in land use and management on different soil types. The output of the modelling is reported to the provincial level. The Census of Agriculture also collects data on soil cover—the number of days in a year that soil has a crop or ground cover—and also report this data to the provincial level (Lefebvre et al., 2005).

Figure 3 Frequency of soil testing, based on data from surveys of those farmers who do soil testing. Includes farmers producing all types of products across Canada.



Source: Reprinted from Crop Nutrients Council (2006).

Wheat that is sown in a continuous crop rotation with lentils has been shown to have higher protein content than wheat sown in a well-fertilized, continuous wheat rotation (Johnston et al., 1999), even though wheat after lentil receives less nitrogen fertilization than the continuous wheat rotation to offset the nitrogen-fixing capacity of the legume. The long-term research trials that produced these results suggest that lentils are contributing more nitrogen to the soil than they are taking up; therefore, a measurement of protein content in wheat grown in rotation with lentils illustrates a direct, measurable economic benefit from conservation tillage and pulse production. Furthermore, protein content is strongly related to soil nitrogen levels and may be used as a proxy for soil fertility. In the research trials, the protein content of wheat planted after lentils increased with time, reflecting an increasing beneficial effect of lentils on soil fertility (Johnston et al., 1999).

2.1 Information infrastructure at the farm and regional levels

The rise of conservation tillage is strongly linked to the rise of pulse production in Canada. Thus, we cannot discuss the information infrastructure around pulse production without also including the soil conservation movement. Herein, "soil conservation movement" largely refers to the efforts carried out in Saskatchewan. The shift toward conservation tillage and pulse production was driven by many different issues and innovations. These can be roughly broken down into environmental, economic, technological and social drivers (see Table 1).

The information infrastructure regarding the change from summer fallow to conservation tillage and pulse production practices is very efficient at bringing information to producers at the farm level. Communications with farmers and researchers have testified to the efficacy of information-sharing among informal networks of farmers. Farmers who adopt practices such as conservation tillage and adding pulses to crop rotations are motivated to do so by the promising results of studies conducted on research farms and at universities, and of projects completed by other farmers. Importantly, this information focuses on the relationships between the practices and their positive and negative environmental and economic impacts. The testimony, usually transmitted through word of mouth, involves the easily observable, aforementioned soil-structure information, as well as crop information such as the uniformity of the crop, the density of the stand, and any issues with residues or stand population. Crop results observed by farmers are passed on to others, along with advice and techniques. Newsletters and extension materials from farm organizations pass on information that tests the conditions under which farmers can optimize the benefits from changing agricultural practices.

Table 1: Drivers of conservation tillage and pulse production.

Environmental sustainability drivers	Issues with soil loss and soil moisture loss from summer-fallow tillage Increasing salinity of soils linked to summer-fallow tillage practices Need for better plant residue management (soil organic content)
Economic drivers	Reduced labour costs, diesel costs and reliance on costly chemical inputs Added revenue of producing a crop in what would have been a "fallow" year with no income Reduced pressure on farmers, due to the increasing size of farms, to curb time-consuming practices such as tillage and summer fallowing Emerging market for lentils Opportunities to grow crops with more marketing options than wheat and barley
Technology drivers	New crop varieties better-suited to climatic conditions Introduction of new forms of crop protection (such as low-cost glyphosate), making continuous cropping easier Integrated pest management schemes that provide alternatives to chemical inputs Innovations in seeding techniques and equipment that make it easier for farmers to switch to no-till practices New crop and herbicide rotations and research into various types of cropping that help farmers find what works best for them
Social drivers	Farm organizations, such as the Saskatchewan Soil Conservation Association, that get the message out about conservation tillage and pulse production Environmental organizations, such as Ducks Unlimited, that encourage more environmentally sound agricultural practices

2.2 Information users and generators

Stakeholders can play any of three important facilitating roles in the information infrastructure, with each group acting as both generators and users of information, passing information on to other actors and levels in a cycle of information generation, adoption, learning, adaptation, application and new information generation. The first group comprises the farmers who adopt conservation tillage early on and innovate on the idea through on-site problem-solving. They are the "core of innovation." Their success stories with planting, harvesting, technology and crop-rotation solutions provide researchers and other farmers with fresh ideas to tackle the obstacles related to adoption of the conservation tillage system. The farmers thus generate information related to their farm practices and outcomes, which is then passed on as an input into the information infrastructure. The second group consists of the researchers and agricultural industrialists who provide the information and technology to motivate positive change. They take the information regarding the farmers' problems and solutions and expand on the core of innovation to come up with management and technological solutions that fit a variety of climatic and soil conditions. The third and possibly most influential group is made up of the farm organizations, such as the Saskatchewan Soil Conservation Association (SSCA), that are instrumental in the information infrastructure around the soil conservation movement and the spread of pulse production.

For example, the SSCA identified conservation tillage as a complicated system and created the five pillars of direct seeding: residue management, crop rotation, crop establishment, fertility management and weed control. For each of these pillars, the SSCA acknowledged that mismanagement in one area may cause problems in the others. With this in mind, they provided technical advice at the regional and farm level, coordinated extension and support to district boards, funded farm demonstrations, and held annual meetings and various forums about soil conservation. One of their most important roles is to be in touch with farmers' experiences with conservation tillage and pulse production and, through this, to identify new research questions as they arise. These farm organizations use information from the farm level to monitor key issue areas to determine priorities for research. They then pose these questions to government and university researchers and help disseminate the solutions through forums and conferences. They are important facilitators of adaptation and learning for feedback to farmers for improved practices and environmental outcomes.

2.3 Barriers and constraints in the information infrastructure at the farm and regional levels

A major barrier to the adoption of conservation tillage and pulse production was that many farmers had tried and failed at transitioning from monoculture and summer-fallow practices. This was a test of the information infrastructure insofar as it challenged the actors involved in delivering the message of conservation tillage to be creative in how the information was disseminated and used. The SSCA responded to this challenge by encouraging farmers to start making smaller changes first, then gain success before expanding. They also identified common mistakes and provided information on how to avoid or correct them. For example, they set up demonstration plots and collaborated on research trials, working with agronomists and crop advisors to make sure the best information was getting to farmers. They also created literature on the "dos and don'ts" of direct seeding and provided grassroots support to farmers who were starting to make the transition. In this way they were able to keep everyone on message about the benefits of switching to conservation tillage and growing pulse crops.

In addition, political boundaries were barriers to the spread of conservation tillage. The mode of dissemination of information by farm organizations such as SSCA was different in each province. The most striking difference was that the SSCA was an independent organization, while cohorts in Alberta and Manitoba were extensions of the government's efforts in soil conservation. This made it more difficult for farm organizations in Alberta and Manitoba to stir controversy, and limited their freedom to make statements that were out of sync with the official government position. This "border effect" is said to have been observed at the farm level in terms of the amount of tillage between fields on either side of Saskatchewan's borders. It was also felt in the amount of positive political momentum around direct seeding and, consequently, in the rate and extent of change in practices. As a result Saskatchewan became a major innovator in pulse-production technology, equipment and management.

2.4 Information infrastructure at the provincial and national levels

Provincial- and national-level reporting is more formal than the networking and information-sharing indicative of farm- and regional-level extension activities. Both the Province of Saskatchewan and the Government of Canada have many metrics (see Table 2) that pertain to pulse production and conservation tillage in Canada. Different groups, such as farmers and researchers, generate information on these indicators, but the national government generates most of the information at this level. These indicators are primarily used by AAFC, as well as for assessing the overall environmental sustainability of pulse production. Other uses include tracking progress and monitoring performance to achieve priority objectives, drawing public attention to important environmental issues, translating scientific knowledge and research results into a form that can be used and understood by citizens and decision-makers, and educating those interested in understanding agri-environmental issues and their implications (Lefebvre et al., 2005). Data at this scale are rarely applicable at the farm level. To address this, AAFC is, in partnership with industry, developing other tools, including environmental farm planning, to help farmers make informed farm-management decisions related to environmental impacts.

Table 2: Indicators important to sustainable pulse production.

Indicator	Who measures	How	Why	Who uses or publishes
Soil organic carbon	Agriculture Canada	Modelling of the rate of change of soil carbon (not applicable to farm level)	Soil organic carbon is important for soils where nitrogen is limiting; along with soil moisture, it is a determinant of soil nitrogen.	Ag-Environmental Indicator Report Series (Lefebvre et al., 2005)
Soil structure: infiltration, porosity, density (mellowness) and draft (ease of tillage)	Individual farmers	Informal assessments when interacting with the soil at the farm level	Improved soil structure is a result of increased soil organic carbon, so if soil organic carbon cannot be measured directly, observations on structure can be proxies.	Farmers
Protein content in wheat	Various researchers; private contractors hired by farmers	Detailed testing in case-study approach	A benefit of pulses is that they can add nitrogen back to the soil for subsequent crops. This is a direct, measurable economic benefit from pulse production in a continuous cropping system.	Scientific papers, e.g. Johnston et al. (2007)
Soil-loss rate (soil erosion from water, wind and tillage)	AAFC	Calculations of water erosion using the Revised Universal Soil Loss Equation; calculations of wind erosion using the Wind Erosion Equation; calculations of tillage erosion using the Tillage Erosion Risk Indicator	The increasing use of conservation tillage, no-till, reduced summer-fallow area and shifts in the types of crops grown have contributed to the reduction in soil erosion. A dramatic increase in the use of direct-seeding technologies contributes to much of the reduction in wind erosion specifically.	Ag-Environmental Indicator Report Series (Lefebvre et al., 2005)

Table 2: Indicators important to sustainable pulse production (continued).

Indicator	Who measures	How	Why	Who uses or publishes
Summer-fallow trends	AAFC; Agriculture Saskatchewan	Measurements of area of summer fallow that is maintained by tillage weed control, by chemical control or by a combination of the two, collected by the Census of Agriculture	Decreasing summer-fallow means that farmers are switching to alternative practices.	Ag-Environmental Indicator Report Series (Lefebvre et al., 2005); Government of Saskatchewan (2009) agricultural statistics
No-till (conservation tillage) acreage as a percent of annually cropped land; total amount of annually cropped land	AAFC	Data collected as part of the Census of Agriculture; *no-till* defined by AAFC as practices that break up the soil and kill weeds but do not turn the soil cover	Trends are toward conservation tillage and away from summer fallow, while overall there is little change in the overall amount of cropped land. Reduced soil erosion slows the rate of mineralization of organic matter.	Ag-Environmental Indicator Report Series (Lefebvre et al., 2005)
Soil cover	AAFC	Number of days per year that soils are covered by a crop	Increasing soil cover trends indicate broadly that cropping practices are changing.	Ag-Environmental Indicator Report Series (Lefebvre et al., 2005)
Soil salinity	AAFC	Risk of soil salinization, calculated using factors such as salinity status, topography and soil drainage classes, growing season climatic moisture deficits and land-use data from the Census of Agriculture	Soil salinity was a major impact of summer-fallow tillage practices.	Ag-Environmental Indicator Report Series (Lefebvre et al., 2005)

Table 2: Indicators important to sustainable pulse production (continued).

Indicator	Who measures	How	Why	Who uses or publishes
Wildlife habitat on farmland	AAFC; Ducks Unlimited Saskatchewan	Habitat capacity index, which can be calculated using habitat suitability matrices	Some combinations of no-till systems can be beneficial to waterfowl nesting on farmland. As well, less soil erosion means better wetland environments in fields.	Ag-Environmental Indicator Report Series (Lefebvre et al., 2005); Ducks Unlimited nesting studies
Acreage, yield and production trends for pulses (peas, lentils, chickpeas)	AAFC; Agriculture Saskatchewan	Trends compiled by Agriculture Saskatchewan from 1989 to 2008; acreage of pulses calculated by Agriculture Canada as a share of the total cropped area	This is important economic information, both as an indicator of the quality and success of Canadian pulses and as an incentive for the adoption of pulse production and conservation tillage.	Government of Saskatchewan (2009) agricultural statistics; Ag-Environmental Indicator Report Series (Lefebvre et al., 2005)
Farm environmental management practices	AAFC	Survey of farm environmental management practices, including water-quality protection and use of mineral fertilizers, pesticides and manure	Integrated environmental management practices are an important part of making pulse production sustainable. In order to weaken the reliance on pesticides, herbicides and fungicides in pulse production, farmers need new systems approaches that can address multiple values.	Ag-Environmental Indicator Report Series (Lefebvre et al., 2005)

3.0 Conclusions

Considerable barriers hamper the links between the broad and farm-level information infrastructures. First, soil structure and crop information that is informally generated and circulated cannot be aggregated to broader levels, though this information is invaluable to the assessment of environmental impacts such as soil erosion and loss of soil fertility. Metrics such as yields, seeded acres, and use intensities for chemicals and fertilizers can be aggregated, but at best these are indirect measurements of environmental impacts. Second, formal information collected by farmers is shared horizontally through the informal network, but proprietary issues can hamper the aggregation and public use of private information. For example, data such as soil organic content, salinity and available nitrogen may be collected as part of soil testing, but this information is not readily aggregated and reported on publicly. The soil-testing industry may keep records on many of these metrics, but the data is kept as internal information and is only shared with the client who has commissioned the work.

The indicators that are related to environmental outcomes of pulse production are mostly generated by provincial and federal government sources. This data is important in measuring end results, but it does not necessarily link farm practices to the myriad efforts occurring at all levels to shape more sustainable agricultural practices. In addition, high-level aggregated indicators can "hide" impacts and usually do not give a very accurate picture of the farming or environmental conditions at a specific location.

Finally, some outcomes will be longer term and are context specific. Many of the farmers, researchers, and government and non-governmental organization employees interviewed for this study expressed the view that the real benefit was felt in the overall crop rotation over the long term. This is a calculation that can only be made in each farmer's specific economic and environmental context.

Information exchange at various levels can occur both formally and informally. The channels of information exchange will need to be appropriate to both the information generators and users. The exchange must offer value for generators of information and transparency regarding uses of information. When the users of information create a feedback loop with the practices and generators of information, learning and adaptation are facilitated. These feedback loops should be in a form and format that is understandable (for example, easily observable) and usable (such as in newsletters and extension materials). This return on value for information generators creates a "virtuous" circle.

Challenges to passing on information include different relevance of information at aggregated and disaggregated levels, confidentiality, and links between farm-level management practices and longer-term, larger-scale outcomes.

The environmental benefits of including pulses in crop rotations in Canada's prairies is a reason to expect that lentils will continue to be a major crop in Saskatchewan. The different stakeholders of this sector all have an interest in working together at different levels, both formally and informally, to better understand the link between farm practices and environmental outcomes, in order to improve and grow the industry.

Interviews

Name	Organization
Blair McClinton	Saskatchewan Soil Conservation Association
Brian McConkey	Semiarid Prairie Agriculture Research Centre
Garth Patterson	Saskatchewan Pulse Growers
Guy Lafond	Indian Head Research Farm
Paul Thoroughgood	Ducks Unlimited Regina
Ray Aspenial	Organic farmer, processor and wholesaler

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