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Integrating and Strengthening the European Research Area

ANNEX

to Deliverable 13 : Product-based assessments to link compliance to standards at farm level to competitiveness

Part I: U.S. Agriculture and its Regulatory Context: The Cases of Dairy, Beef, Swine, and Fruits and Vegetables

Part II: Costs of compliance to environmental regulations in Canada; Case study on cereals

Part III: New Member States and Cross-Compliance: The Case of Cereals and Beef in Poland

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Authors of this report and contact details

Name:
Roel Jongeneel Partner acronym: LEI (editor)
Irina Bezlepkina Partner acronym: LEI (editor)
Jonathan Winsten Partner acronym: Winrock
Glenn Fox Partner acronym: University of Guelph
Predrag Rajsic Partner acronym: University of Guelph
Zbigniew Karaczun Partner acronym: SGGW

Contact Address:
Alexanderveld 5
2585DB The Hague
The Netherlands
Email: roel.jongeneel@wur.nl

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General Introduction

The prime aim or the project was on assessing the impacts of compliance with standards, more specifically those part of cross-compliance, on EU's external competitiveness. This is why in several deliverables and also in the main text of this Deliverable 13 a lot of attention is given to the EU and EU regulations. However, also an extensive analysis was made of some key competitors to the EU, notably New Zealand, the US and Canada. This annex integrates the elements of this comparative analysis, in particular to the extent choices about these countries have been included in the competitiveness assessment (expected percentage cost increases for farmers and sectors due to regulations which have a certain degree of equivalency with the ones analysed for the EU). Also a separate discussion of the Polish case was added in order to more in detail highlight the challenges new member states face from implementing and monitoring cross-compliance.

This Annex consists of three parts:

Part I presents an overview of the US agriculture with specific reference to case studies carried out for beef sector, swine industry and fruits and vegetables. The case study carried out for the dairy sector is integrated into Chapter 4 of the main document. The annex presents the regulatory context in the US, among which the Clean Water Act (including Comprehensive Nutrient Management Planning (CNMP)), the Clean Air Act, various conservation reserve programs play a prominent role. This is followed by discussions on specific industries in the US for which the assessment of cost of compliance is made, notably the beef, swine (Iowa) and fruit sector (Florida citrus and California Tomatoes cases). Part of the US study also focused on dairy, but this has been fully integrated into Chapter 4 and is therefore not reported about separately.

Part II presents the Canadian case, with a focus on cereals. An extensive analysis is made of the role of regulations which are similar (although usually not equivalent) to the EU's cross compliance related standards. In particular attention is paid to the role and functioning of the so-called Best Management Practices, which are interpreted as having a certain equivalence with the EU's GAEC requirements. Since the Canadian philosophy to regulation differs from the one in the EU (the EU applying obligatory legal requirements) in which voluntary participation and different incentive schemes (cost sharing, subsidies, information communication rather than financial punishments) play a role, also the impact of this is further analysed.

Part III presents an in-depth analysis of the Polish case, with special reference to its cereals and beef sector. The analysis carried out for Poland has been focused on issues of implementation and impacts taking into account the special position of new member states. In the new member states as part of cross-compliance farmers eligible for direct payments have to satisfy the GAECs. From 2009 and onward also the SMRs will be part of the cross-compliance package and non-compliance with SMRs can lead to a reduction in direct payments. It provides a discussion of the challenges the implementation of CC imposes to the policy maker as well as the required institutional capacity that has to be built up. Attention is paid to the various institutions involved, the farm advisory service, monitoring and control and the gradually phased in implementation. More specifically the implementation of the cross compliance package to the cereals and beef sectors is discussed, including regulation

specific issues. In the concluding section an effort is made to draw some lessons for new member states and formulate some main conclusions.

Parts and results of the research reported in this Annex have been integrated in various places into the analysis done in the main report.

Part I: U.S. Agriculture and its Regulatory Context: The Cases of Dairy, Beef, Swine, and Fruits and Vegetables

1 Introduction

This Annex consists of three parts. Part I presents an overview of the US agriculture with specific reference to case studies carried out for beef sector, swine industry and fruits and vegetables. The case study carried out for the dairy sector is integrated into Chapter 4 of the main document. The annex presents the regulatory context in the US, among which the Clean Water Act (including Comprehensive Nutrient Management Planning (CNMP)), the Clean Air Act, various conservation reserve programs play a prominent role. This is followed by discussions on specific industries in the US for which the assessment of cost of compliance is made, notably the beef, swine (Iowa) and fruit sector (Florida citrus and California Tomatoes cases). Part of the US study also focused on dairy, but this has been fully integrated into Chapter 4 and is therefore not reported about separately.

2 U.S. Agriculture: A Primer

Although the US has federal regulations that apply in all states, each of the 50 US states can and will have its own interpretation and enforcement of these regulations. Additionally, many states have there own regulations that are not part of federal mandates. For these reasons, it is important to know which states are the leading producers of the commodities included in this project's analysis. The tables below show the top 10 states for production of each commodity of concern.

Table 1 shows that corn production is dominated by the Northcentral states, known as the Cornbelt. Over 55% of US production originates in just 5 states, led by Iowa with almost 20%. A very similar production pattern exists for soybeans, as shown in Table 2. With regard to wheat, Kansas, North Dakota, and Montana lead the US in production, accounting for more than 40% of the total production. This is shown in Table 3.

Dairy production is much more dispersed across the US. In recent years, western states such as California, Idaho, and New Mexico have greatly increased their milk production. The top 10 dairy states are listed in Table 4. California has overtaken Wisconsin, the historical hub of US dairying, to be the largest producer. Average herd sizes in the western states are vastly greater than those in the traditional Dairybelt (the northern tier, from Maine to Minnesota). The larger herd sizes are the object of recently enforced Clean Water Act and Clean Air Act regulations, making some western states, particularly California a logical choice for analysis of the dairy sector.

Poultry production is dominated by the south-eastern and Mississippi Delta states, lead by Georgia, Arkansas, and Alabama, as shown in Table 5. Swine production is dominated by

Iowa, with almost 22% of the 2004 US total. North Carolina and Minnesota are the number two and three states for swine production, respectively. The top 10 swine states can be seen in Table 6.

Map 1 shows the concentration of dairy cattle at the county level as of 1997. The USDA report that these maps are taken from shows significant changes in the geography of production and frequency of farms with greater than 1,000 animal units. Such farms that feed animals primarily in confinement are designated by Clean Water Act rules as Concentrated Animal Feeding Operations (CAFOs) and are the focus of water quality regulations at the federal and state levels.

Vertical integration is common in the US swine industry, which, along with poultry, has had the fastest rate of growth of CAFOs. Map **2** shows that the greatest concentration of swine exist in the North central states, lead by Iowa and Minnesota, as well as in North Carolina, where recent breaches of large manure lagoons have caused serious environmental concerns. Air quality and odor control have become important issues facing large-scale hog production in many regions of the country.

Poultry production is centered in the Southeastern and Southcentral states, lead by Georgia, Arkansas, Alabama, and Mississippi. Important structural changes over the past 15 years include widespread vertical integration in the poultry industry. The majority of large producers are contract growers for poultry processing and marketing firms. Most often, contract growers do not own the birds; they are supplied with chicks, feed, and management oversight. This arrangement has been the focus of much debate regarding the lack of liability of the integrator (i.e. processor) for environmental degradation resulting from poultry production. Map 3 shows the concentration of poultry by county as of 1997.

The beef cattle industry in the US has two distinct components. Cow-calf operations produce young stock primarily on pasture and rangeland. This occurs in the western and inter-mountain states, as well as in the southern states. Feedlot operations take yearlings and steers and fatten them for slaughter. It is feedlot operations that are facing increasing regulation as CAFOs. The western plains states, such as Nebraska, Colorado, Wyoming, Oklahoma, and the Texas panhandle have the majority of beef CAFOs.

Map 4 shows the concentration of beef cattle by county.

Table 1: Top ten corn producing states in US in 2004

State	Corn (1000 bushels)	% of total
Iowa	2,178,750	19.75%
Illinois	1,732,750	15.71%
Nebraska	1,287,400	11.67%
Minnesota	1,162,800	10.54%
Indiana	868,250	7.87%
South Dakota	485,850	4.40%
Ohio	460,460	4.17%
Kansas	429,000	3.89%
Wisconsin	427,500	3.88%
Missouri	318,600	2.89%

Source: USDA National Agricultural Statistics Service database.

Table 2: Top ten soy producing states in US in 2004

State	Soy (1000 bushels)	% of total
Iowa	532,650	17.50%
Illinois	434,700	14.28%
Minnesota	299,200	9.83%
Indiana	257,760	8.47%
Nebraska	227,850	7.49%
Ohio	196,680	6.46%
Missouri	178,200	5.86%
South Dakota	138,600	4.55%
North Dakota	109,150	3.59%
Kansas	103,600	3.40%

Source: USDA National Agricultural Statistics Service database.

Table 3: Top ten wheat producing states in US in 2004

State	Wheat (1000 bushels)	% of total
Kansas	380,000	18.05%
North Dakota	303,765	14.42%
Montana	192,480	9.15%
Washington	139,300	6.62%
South Dakota	133,420	6.34%
Oklahoma	128,000	6.08%
Idaho	100,590	4.78%
Texas	96,000	4.56%
Minnesota	71,470	3.40%
Nebraska	68,640	3.26%

Source: USDA National Agricultural Statistics Service database.

Table 4: Top ten dairy producing states in US in 2004

State	Dairy (mill lbs)	% of total
California	36,465	21.35%
Wisconsin	22,085	12.93%
New York	11,650	6.82%
Pennsylvania	10,062	5.89%
Idaho	9,093	5.32%
Minnesota	8,102	4.74%
New Mexico	6,710	3.93%
Michigan	6,315	3.70%
Texas	6,009	3.52%
Washington	5,416	3.17%

Source: USDA National Agricultural Statistics Service database.

Table 5: Top ten poultry producing states in US in 2004

State	Poultry (1000)	% of total
Georgia	26,376	15.62%
Arkansas	24,497	14.51%
Alabama	21,136	12.52%
Mississippi	16,528	9.79%
LA & MO Combined	15,226	9.02%
North Carolina	14,123	8.36%
Texas	11,457	6.79%
Maryland	6,470	3.83%
Kentucky	6,077	3.60%
Oklahoma	5,505	3.26%

Source: USDA National Agricultural Statistics Service database.

Table 6: Top ten swine producing states in US in 2004

State	Head Marketed (1000)	% of total
Iowa	22,223	21.91%
North Carolina	13,295	13.71%
Minnesota	9,201	9.49%
Illinois	8,300	8.56%
Indiana	6,906	7.12%
Nebraska	6,397	6.60%
Missouri	5,934	6.12%
Ohio	3,238	3.34%
South Dakota	2,260	2.33%
Kansas	2,404	2.07%

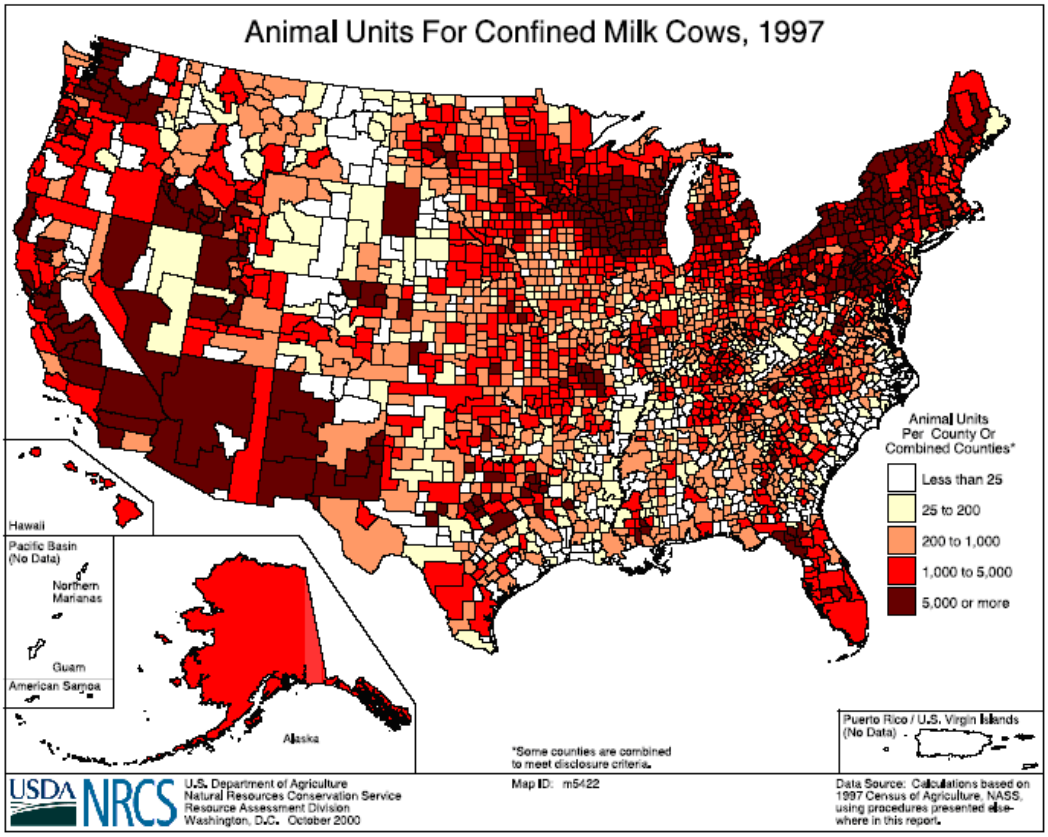
Source: USDA National Agricultural Statistics Service database.

Table 7: Top feeder cattle states in U.S., 2007

State	Feeder Cattle (1,000 head)	% of Total
Texas	2,870	26.70%
Kansas	2,140	19.90%
Nebraska	2,050	19.10%
Colorado	940	8.80%
California	545	5.10%
Iowa	510	4.70%
Oklahoma	325	3.00%
All other states	892	12.70%

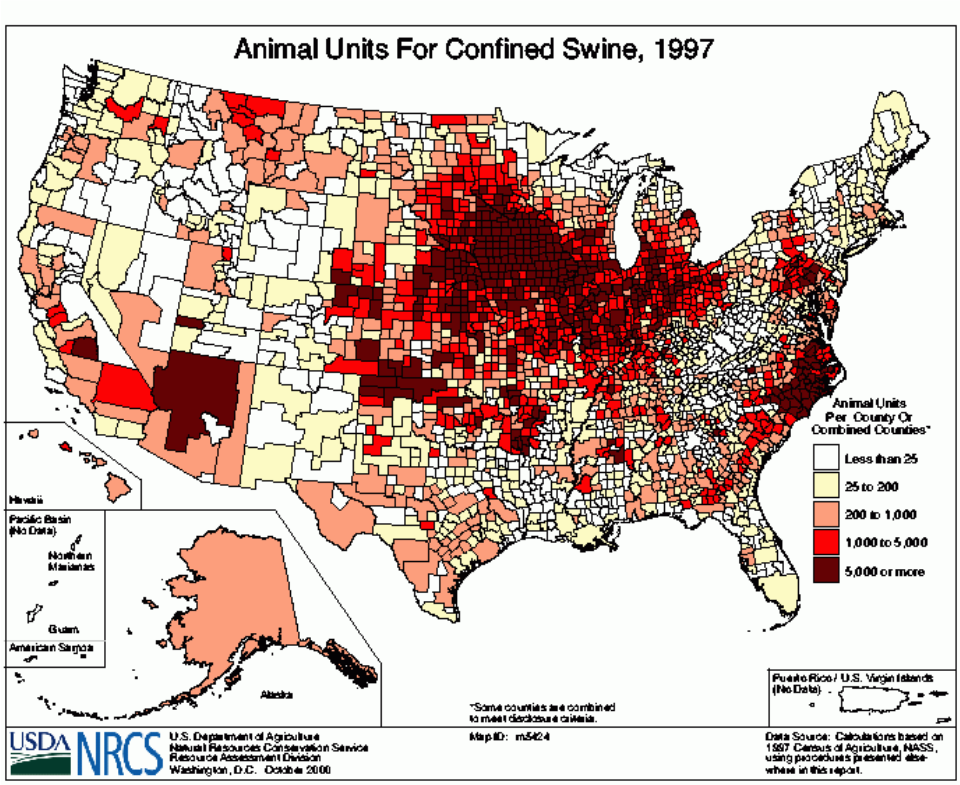
Source: USDA National Agricultural Statistics Service

Map 1: Spatial distribution of dairy cattle



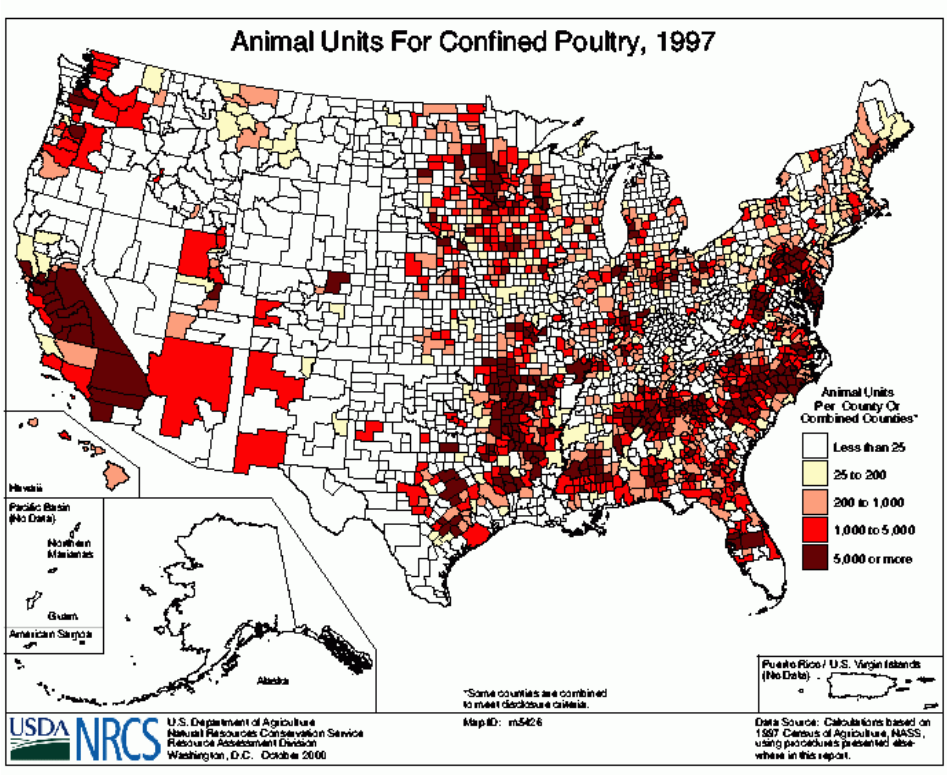
Source: Kellogg et al. 2001.

Map 2: Spatial distribution of swine production



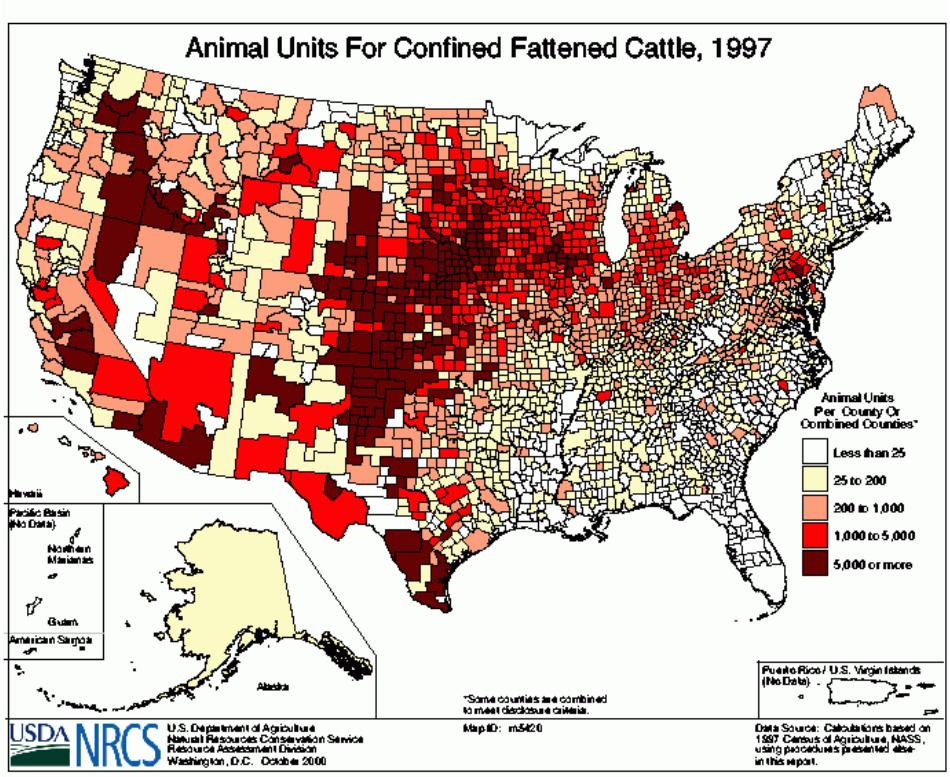
Source: Kellogg et al. 2001.

Map 3: Spatial distribution of poultry production



Source: Kellogg et al. 2001.

Map 4: Spatial distribution of beef cattle



Source: Kellogg et al. 2001.

3 The Regulatory Context

A handful of federal agencies are in charge of the implementation, oversight, and enforcement of regulations affecting agricultural production. These include the Environmental Protection Agency (EPA), the Department of Agriculture (USDA), the Food and Drug Administration (FDA), and the Department of Interior. However, because many federal regulations are administered at the state level, the aforementioned federal agencies often delegate authority to respective state agencies for implementation and enforcement. The states then have some leeway in how they administer the regulations.

In general, agriculture in the U.S. seems to have fewer mandatory standards imposed upon producers through regulations as compared with the 19 Directives that are relevant to agriculture in the EU. In the U.S., the primary approach for addressing similar issues has been to use voluntary compliance that is supported with cost-share funds. There are, however, several important mandatory compliance issues that are addressed in this analysis.

3.1 Federal Water Pollution Control Act Amendments of 1972 (Clean Water Act)

Background and general description. The Clean Water Act (CWA) is the primary law protecting surface water quality in the U.S. It employs a variety of regulatory and non-regulatory tools to reduce pollutant discharges into the nations waterways. Initially, the primary focus was on point sources of pollution from industry and wastewater treatment plants (WWTPs), with little attention paid to nonpoint sources. The focus in recent years has been expanded to include nonpoint source pollution (NSP). Agriculture has been identified as the primary source of NSP affecting U.S. surface waters (EPA 2002).

Impact on agriculture. The CWA includes regulation of farming activities. However, it was not until December 15th, 2002 that the federal government issued specific rules governing Concentrated Animal Feeding Operations (CAFOs). CAFOs are typically defined as animal feeding operations with greater than 1,000 animal units (700 dairy cows, 1,000 beef cows, 2,500 hogs, or 100,000 chickens). Smaller operations can also be designated as CAFOs, however, if specific environmental conditions apply. *Medium CAFO*s are those operations with between 300 and 1,000 AUs with a stream running through the confinement area, or a man-made conveyance to surface water (Kentucky DOW 2003). *Small CAFOs*, are those operations with less than 300 AUs that, through on-site inspection, have been determined to be a significant contributor of pollutants to surface water (Kentucky DOW 2003).

Under the recent rule, all farms designated as CAFOs are required to obtain a permit under the National Pollution Discharge Elimination System (NPDES). The NPDES permits have been used to control point sources of pollution since the Clean Water Act was established. The CAFO rule is the first application of the NPDES permit to agricultural nonpoint sources of pollution. The rationale for this rule is that large farms (CAFOs) are potential point sources of pollution because of their large manure storage requirements.

Obtaining an NPDES permit for a CAFO requires the design and implementation of a comprehensive nutrient management plan (CNMP) for the operation. The CNMP must be

specific for the operation and detail the proper management of all animal manure produced. It must address the assimilative capacity of the farm's land for the manure and other nutrients applied to the land. The CNMP must be focused on the control of nitrogen (N) or phosphorus (P), based on state or local priorities. The implementation of CNMPs often result in operations seeking additional land on which to spread manure and/or the use of alternative nutrient control strategies for manure.

It is important to note that the CAFO regulations currently affect a very small percentage of livestock operations. The USDA estimated that CAFOs accounted for 2 percent of all confined livestock operations in 1997 (Gollehon et al. 2001). Although an updated estimate is not available, the current percentage is likely to be much higher, but probably less than 5%. The percentage of CAFOs varies across livestock types, with the greatest percentage of CAFOs in the swine and poultry sectors (Kellogg et al. 2001; Speir et al. 2002). Due to their larger size, the percentage of hectares affected by the CAFO regulations is much greater than the percentage of operations, but is still estimated to be a fairly small percentage.

The CWA also provides regulations concerning the application of sewage sludge to agricultural land. During the 1980s and 1990s, numerous studies and reviews were conducted in the US to ascertain the risks of using sewage sludge as an amendment on land used for food crops. Both the USEPA and USDA have been proponents of using bio-solids on agricultural land. The regulations that govern the use of this practice set concentration limits for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. Additionally, proper practices for field storage are provided through this rule. The Table 8 provides a description of the issues and options related to the use of sewage sludge in agriculture.

Implementation and approach. The implementation and enforcement of the CWA is delegated to the states. Each state has an authorized NPDES authority, usually the state agency responsible for natural resources and/or environmental quality. Each state's NPDES authority is responsible for issuing the permits and enforcing the related regulations and standards. This includes implementation of the CAFO rule. In most states, the agency of agriculture is also involved in this process, as it affects some portion of livestock operations. The most relevant issues in the CAFO process are (1) the threshold size of an operation for designation as a CAFO and (2) the stringency of CNMP standards and enforcement.

3.2 Interaction between EPA's CAFO rule and State and Local Regulations

Most states already have some water quality regulations that affect farms. Some states have more stringent criteria, while in other states, EPA's regulations will prove to be more stringent than their existing regulations. NRCS practice standards are designed to meet federal, state, and/or local requirements, whichever are most stringent. State and local NRCS offices must be aware of all applicable regulations and adapt their planning activities as required.

State and local regulations can vary greatly, depending upon how they chose to define CAFOs, and related criteria. These definitions were not consistent among states or with the previous EPA definition. For example, the level of acceptable discharge may be different between existing state and local regulations and the current CAFO rule. Finally, prior to the

current CAFO rule, CAFOs that already have implemented practices meeting the 24-hour, 25-year storm event criteria were exempt from the National Pollution Discharge Elimination System (NPDES) permit requirement. These farms must now acquire a permit, even though they are most likely meeting the permit requirements.

In the states that have less restrictive local and state regulations, relative to the CAFO regulations, NRCS and its conservation partners in these states can expect to see an increase in technical service assistance requests from farm operators that now must apply for, and comply with, CAFO NPDES permits. To more thoroughly assess the types of assistance that will be required, each state and local office will need to determine and understand the relationship between EPA's CAFO regulations and their state and local laws. If the CAFO rule is more restrictive than current state and local regulations, NRCS will need to assure that their Field Office Technical Guide (FOTG) Quality Criteria and conservation practice standards reflect the CAFO requirements.

Many states are anticipating future changes to the CAFO rule and creating regulations for operations that are smaller than those currently defined as CAFOs in the rule. Maryland, central in the Chesapeake Bay watershed, is one of the few states to require CNMPs for all livestock operations, regardless of herd size. The issue of stocking rate is not currently used as a criterion for designating farms as CAFOs, even though it may be a more relevant guideline.

Farm-level costs of adhering to regulation. The costs of implementing a CNMP will vary widely across farms and regions of the US. As an example, it was calculated that the average hog CAFO in the Mid-Atlantic region would need to increase the amount of available land for manure spreading by almost 500% in order to comply with a N-based CNMP. Obviously, the amount of additional land required, and the associated costs, vary widely from farm to farm and region to region. However, the overall effect will most likely be an increase in land prices and rents.

Additional costs for compliance with CWA regulations may include investments in manure storage, treatment, and handling. However, much of this cost is often borne by federal and state government programs. Also, the cost of third party technical service providers to assist farming operations with planning and compliance issues are incurred by many farms.

The United States Department of Agriculture (USDA) has estimated the costs for developing and implementing a successful CNMP. Documentation of these costs can be found in USDA's "Costs Associated with Development and Implementation of Comprehensive Nutrient Management Plans. Part 1 - Nutrient Management, Land Treatment, Manure and Wastewater Handling and Storage, and Recordkeeping". Table 8, presented below, provides the typical costs of the various components required in a CNMP by animal sector and farm size in the United States. These costs are the basis for calculating the CNMP costs of the dairy, hog and beef operations described in this document.

Table 8: Costs per farm for Comprehensive Nutrient Management Planning (CNMP) requirement

								Total CNMP implementation costs per farm			
Dominant Livestock Type	Number of farms	Animal units per farm**	Record-keeping costs per farm	Nutrient management costs per farm	Off-farm transport costs per farm	Land treatment costs per farm	Manure costs per farm	Average	Low***	High***	Per animal unit
			($/yr)	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)
Fattened cattle	10,159	1,298	142	1,655	4,646	2,613	9,112	18,167	1,026	308,005	14
Dairy	79,318	195	160	2,101	1,619	2,660	3,249	9,788	2,362	97,013	50
Swine	32,955	276	224	1,601	2,450	3,615	4,139	12,029	2,060	75,159	44
Broilers	16,251	183	90	248	1,667	1,220	2,351	5,576	1,128	36,187	30
Farm Size											
Large	19,746	1,419	168	1,526	9,679	3,925	15,167	30,465	2,199	252,014	21
Medium	39,437	252	150	1,085	2,281	2,897	3,397	9,809	1,210	64,426	39
Small	198,018	80	106	987	345	1,267	1,070	3,773	161	25,298	47
All Farms	257,201	210	117	1,043	1,358	1,721	2,509	6,748	195	67,429	32

Source: "Costs Associated With Development and Implementation of Comprehensive Nutrient Management Plans. Part 1 - Nutrient Management, Land Treatment, Manure and Wastewater Handling and Storage, and Recordkeeping." USDA NRCS. June 2003. Table 38. pg. 105

** Represents **all** animal units on the farm, but does not include animal units for specialty livestock types, which were not estimated.

*** The **low** estimate corresponds to the one-percentile value for the farms in each group, and the **high** estimate corresponds to the 99th-percentile value.

3.3 The Clean Air Act

Background and general description. The Clean Air Act (CAA) was created as Federal law in 1990 in order to regulate air emissions from area, stationary, and mobile sources. The law authorizes the U.S. Environmental Protection Agency to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment. The CAA directs the states to develop state implementation plans (SIPs) applicable to appropriate industrial sources in the state. Originally, the goal was to attain the NAAQS in each state by 1975. However, progress was very slow. The law was amended in 1977 primarily to set new goals (dates) for achieving attainment of NAAQS since many areas of the country had failed to meet the deadlines. The CAA was amended again in 1990 to address problems not previously focused on, such as acid rain, ground-level ozone, stratospheric ozone depletion, and air toxics (USEPA, n.d.d.).

The Clean Air Act, which was last amended in 1990, requires the Environmental Protection Agency to set National Ambient Air Quality Standards (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act established two types of national air quality standards. "Primary standards" set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. "Secondary standards" set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

The EPA Office of Air Quality Planning and Standards (OAQPS) has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are Carbon Monoxide, Lead, Nitrogen Dioxide, Ozone, and Sulfur Dioxides, Particulate Matter PM_{10}, (which has been revoked), and $PM_{2.5}$. PM_{10} pollution includes "inhalable coarse particles," with diameters larger than 2.5 micrometers and smaller than 10 micrometers and $PM_{2.5}$ includes "fine particles," with diameters that are 2.5 micrometers and smaller.

EPA uses these six "criteria pollutants" as indicators of air quality and has established for each of them a maximum concentration above which adverse effects on human health may occur. Areas of the country where air pollution levels persistently exceed the national ambient air quality standards may be designated "non-attainment" areas. Once these non-attainment areas are determined, states must develop Implementation Plans which outline what actions will be undertaken to address the pollutants and the timeframe needed.

Impact on agriculture. Agricultural production can emit a wide variety of material into the air. These include dust, a variety of nitrogen gases, particulate matter from diesel engines and controlled burning of fields, and pesticides. Potential pollutants associated with agriculture include internal combustion engines, dust from dirt access roads, hydrogen sulfide, ammonia, odors, and other volatile organic compounds from animal manure; methane from dairy cows and cattle; and nitrogen oxides from fertilized fields. Such pollutants can affect human health, reduce visibility, contribute to global warming, and/or be a nuisance to neighbors.

Air quality is protected primarily through the Clean Air Act and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). When the air quality standard for any of six air pollutants is exceeded, states must inform the U.S. EPA on how they plan to respond. Any farm found to be a "major source" of regulated emissions in a

region where air quality standards are exceeded could be required to apply for and comply with an operating permit.

Like other nonpoint source pollution issues, air pollution emissions from agriculture tend to be generated diffusely over a broad land area, rather than from a single pipe or smokestack, so it has not been cost-effective to accurately monitor emissions from individual agricultural sources using current technology. The potential cost of monitoring agricultural air pollution is one reason that agriculture has been lagging behind in compliance with environmental regulations (Ribaudo and Weinberg 2005).

Approach and implementation. Similarly to the CWA and other federal legislation, each state is responsible for implementing the CAA. It makes sense for states to take the lead in carrying out the CAA, because pollution control problems often require special understanding of local industries, geography, housing patterns, etc. Each state has a State Implementation Plan (SIPs) that explains how the NAAQS will be attained. The EPA must approve each SIP; EPA can take over enforcing the CAA in that state if a SIP is unacceptable (EPA, n.d.b.).

New regulations in many states are seeking to reduce air emissions from agriculture, particularly from animal feeding operations (AFOs). Air quality regulations seem to be most significantly affecting agriculture in California. Ozone and particulate levels in the San Joaquin Valley have led to new requirements for agricultural producers, as this region has some of the most polluted air in the country. Farmers in this area must develop management plans showing how they will reduce dust, the burning of crop residue (e.g., rice straw, orchard trimmings) is restricted, and large dairies must manage their manure to reduce ammonia emissions (Ribaudo and Weinberg, 2005). Two specific air-quality regulations impacting agriculture in the San Joaquin Valley include rules 4550 (for Particulate Matter 10), and 4570 (for Volatile Organic Compounds, including ammonia emissions). Operations meeting the defined criteria must obtain air quality permits and agree to implement conservation management practices which document reductions in air emissions. The two case studies in this analysis that could be impacted by these rules include California dairy and fresh tomato producers.

3.4 Methyl Bromide Phaseout

Methyl bromide has been used in the U.S. for decades to control insects, nematodes, pathogens, and weeds. It is used for soil fumigation before planting many fruits, vegetables, ornamentals, and agricultural nurseries; for post-harvest fumigation of commodities in storage and prior to shipment; and for government-required quarantine treatment to prevent the spread of regulated exotic pests

The Montreal Protocol is a treaty designed to protect the stratospheric ozone layer, which protects the earth from harmful solar radiation. The Protocol controls global production and trade of ozone depleting substances. The Parties to the Protocol classified methyl bromide as an ozone-depleting substance and agreed to phase out the use of methyl bromide by 2015, except for critical uses.

The net annual loss to consumers and producers of not having methyl bromide for selected pre-plant uses is estimated to be in the range of $400-450 million: $150-200 million for annuals (strawberries, tomatoes, and other vegetables), $140 million for perennial crops, and $100 million for ornamentals and nurseries (excluding forest nurseries). These losses represent 8-10 percent of revenues for the annual crops (15-20 percent for strawberries, 4 percent for tomatoes),

3 percent for the perennial crops, and 15 percent for the ornamental and nursery crops[1].

Florida fresh tomato producers use significant amounts of methyl bromide due to the more humid and higher rainfall climatic conditions there. The combination of methyl bromide and chloropicrin has been used extensively on Florida tomatoes to suppress crop pests such as nematodes, diseases/fungi and weeds. In 1992 and 1993, approximately 3,500 to 4,000 metric tons of methyl bromide, approximately 14 percent of the U.S.' total annual methyl bromide consumption (3,500 to 4,000 metric tons) was used on the Florida tomato crop[2]. It is estimated that in order to comply with the methyl bromide ban by switching to what EPA considers an equally effective alternative treatment, would cost Florida tomato producers an additional $56 per acre. Additionally, telone, a substitute for methyl bromide, is also a highly regulated chemical that has its own restrictions and considerations to contend with, and several counties in Florida have restrictions on its use.

In California, some methyl bromide is used in the southern coast region (where there is higher rainfall and humidity), but not regularly used in the Central and San Joaquin Valleys, where a Mediterranean-type climate limits fungal and bacterial disease problems in tomatoes[3]. However, California strawberry producers have historically been a significant user of methyl bromide in their production practices.

3.5 Comprehensive Environmental Response, Compensation, and Liability Act and the Emergency Planning and Community Right-to-Know Act (EPCRA)

The reporting requirements of these laws are triggered when large quantities of certain substances are released to the environment, including ambient air. Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires reporting to the federal government of ammonia releases from a facility in excess of 100 pounds per day. The Emergency Planning and Community Right-to-Know Act (EPCRA) section 304 requires reporting to state and local governments of ammonia releases that must be reported to the federal government under CERCLA section 103.

Livestock facilities emit hydrogen sulfide and ammonia, which are reportable substances under these laws. Until now, there has been little enforcement of these provisions against

[1] Carpenter, Janet, Leonard Gianessi, and Lori Lynch. *The Economic Impact of the Scheduled U.S. Phaseout of Methyl Bromide.* National Center for Food and Agricultural Policy, 2000. <www.ncfap.org/pesticid.htm>

[2] Telone® C-17 and Tillam Use on Florida Fresh Market Tomatoes", US EPA http://www.epa.gov/spdpublc/mbr/casestudies/volume1/telc17ti.html

[3] Phone conversation with Charles Rivara, President, California Tomato Research Institute, 8/17/2007

livestock operations, but in lawsuits brought by citizen groups, federal courts in two circuits have found AFOs in violation of the reporting requirement provisions of the laws. As animal agriculture becomes more concentrated, these laws will come more to the forefront.

EPA has developed a Safe Harbor Agreement for AFO/CAFOs for air quality[4]. The agreement applies to AFOs in the egg, broiler chicken, turkey, dairy cattle, and swine industries. However, it does not address AFOs that only have open-air feedlots, such as cattle feedlots. Those that sign up to participate will pay a civil penalty ranging from $200 to $1,000, depending on the number of animals at the AFO, and will contribute $2,500 per farm to implement a nationwide air monitoring program for AFOs. In exchange, the EPA will issue a covenant not to sue and a waiver from liability that covers an AFO's liability for failing to comply with certain provisions of CERCLA, EPCRA, and the CAA retroactively and from the start of the agreement up to the time it reports releases and applies for and receives relevant Clean Air Act permits (i.e., 120 days after publication of estimating methodologies) or December 31, 2011, whichever is earlier.

3.6 1985 Farm Act (as amended in 1990, 1996 and 2002- Conservation Compliance Provisions

Typically known as "HEL", "Sodbuster" and "Swampbuster", USDA compliance provisions require agricultural producers to implement soil conservation systems on highly erodible cropland, and land converted from permanent sod, and refrain from draining wetlands in order to remain eligible for benefits from selected Federal agricultural programs, including price support loans, income support payments and USDA conservation program payments and technical assistance.

On highly erodible (HEL) cropland that has been previously cropped, a conservation system must be implemented that provides for a substantial reduction in soil erosion from the level existing before the conservation measures were applied. The conservation system must include treating sheet and rill, wind, and ephemeral and classic gully erosion. Erosion on HEL cannot exceed twice the soil loss tolerance level (T) for the predominant highly erodible soil map unit in the highly erodible field.

On HEL cropland that is broken out of native vegetation (Sodbuster), a conservation system must be implemented that provides for no increase in soil erosion from the level existing before the conservation measures were applied. The conservation system must include all treatments and measures needed to meet the HEL requirements.

In addition to the sodbuster provisions, there is also a swampbuster provision. Swampbuster is violated if a farmer converts a wetland to cropland. Violations of either sod- or swampbuster should result in the loss of all USDA program payments for that year and for the years that follow. In the case of swampbuster, the penalty can apply until the wetland's functions and values are restored. There are allowances for producers to convert wetlands for production of an agricultural commodity, if they compensate (through mitigation) for the wetland functions that are lost.

[4] http://www.nationalaglawcenter.org/assets/crs/RL32947.pdf

Conservation system costs for these provisions are accounted for in this document as a component of the comprehensive nutrient management plan (CNMP) land treatment costs in the dairy, hog and beef cattle case studies.

3.7 Farm Bill Programs - Conservation Title

Conservation programs administered by USDA take the "Carrot", or voluntary approach, as opposed to the regulatory approach. Should producers choose to sign up for these programs, they could receive technical and financial assistance in order to help them achieve their environmental goals. These programs are basically divided into two main types: land retirement and working lands programs. "Liquidated Damages", or requirements to pay back program funds, can be incurred if producers choose to participate in these programs, but then fail to comply with the terms of the contract. Although these programs are considered mandatory funding programs (i.e. Congress and the President's Office and Management and Budget must allocate funds annually in the budgeting process), there is not a guarantee that any individual producer will be funded under these programs. Many of the programs require a ranking of applications, usually based upon the estimated amount of benefits that society will achieve should the producer be funded and implement the conservation systems. Those producers submitting applications with the highest benefits in relation to cost are usually the first to be funded.

3.8 Conservation Reserve Program, Conservation Reserve Enhancement Program, Wetland Reserve Program, and Grassland Reserve Program

These programs are all land retirement programs. The Conservation Reserve Program and Conservation Reserve Enhancement Program provide contracts that pay producers to retire environmentally sensitive lands from agricultural production. CRP provides annual rental payments and cost-share assistance to establish long-term, resource conserving covers on eligible farmland. Participants enroll land into CRP contracts for 10 to 15 years. The Wetland Reserve Program allows funding for purchasing conservation easements on sensitive wetlands. The Grassland Reserve Program provides easements or rental agreements for landowners to restore and protect grassland, rangeland, pastureland, and shrubland and provides assistance for rehabilitating grasslands. The program is intended to conserve vulnerable grasslands from conversion to cropland or other uses and to conserve valuable grasslands.

3.9 Environmental Quality Incentives Program, Conservation Security Program, Wildlife Habitat Incentive Program, and Farm and Ranchland Protection Program

These programs are all considered working-land programs, or programs that provide cost share and other financial assistance to private agricultural landowners in order to implement conservation systems on their land. The Environmental Quality Incentives Program (EQIP) provides technical assistance and up to 75 percent cost share (states often contribute additional funds to increase this percentage), as well as incentive payments for conservation practices that deal with soil, water, air, plant, and animal (SWAPA) resource concerns. Sixty percent of the funds must be used to address livestock-related issues. This program is highly competitive and requests for funding largely exceed available funding.

The Conservation Security Program (CSP) provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. CSP contract payments include one or more of the following:

• An annual stewardship component for the existing base level conservation treatment.

• An annual existing practice component for the maintenance of existing conservation practices.

• An enhancement component for exceptional conservation effort and additional conservation practices or activities that provide increased resource benefits beyond the prescribed level.

• A one-time new practice component for additional needed practices.

Funding for CSP has been limited, therefore the program has only been offered in limited areas of the country.

The Wildlife Habitat Incentive Program (WHIP) provides technical assistance and up to 75 percent cost-share assistance for farmers who want to develop and improve fish and wildlife habitat primarily on private land. The Farm and Ranchland Protection Program (FRPP) is a program for purchasing development rights and placing easements on land in order to keep productive farm and ranchland in agricultural uses. This program has the greatest support and use in areas where prime agricultural land is under the greatest development pressure.

Although many farms have successfully obtained funding in order to implement conservation systems that address many of the regulations previously described, these programs continue to have greater demand for funding than available funds. In reality, producers may sign up for one or more of these programs and wait to hear whether they are accepted. If they are out of compliance with any regulations and have not been accepted, they have little alternative than to either stay out of compliance (and risk regulatory action) or expend additional capital.

3.10 Other USDA Conservation Programs

3.10.1 PL-566, Small Watershed Protection Act

This program allows USDA Natural Resources Conservation Service to cooperate with States and local agencies to carry out works of improvement for soil conservation and for other purposes including flood prevention; conservation, development, utilization and disposal of water; and conservation and proper utilization of land. These works include cost sharing to producers to implement conservation practices that meet this intent. Funding for PL-566 is non-mandatory and appropriated by Congress. In recent years the funding for this program has been significantly curtailed.

3.10.2 Emergency Conservation Program (ECP)

Emergency Conservation Program (ECP) provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters and for carrying out emergency water conservation measures in periods of severe drought. Funding for ECP is non-mandatory and appropriated by Congress.

3.10.3 2007 Farm Bill

The 2007 Farm Bill is currently being debated in the U.S. Congress. Although there are significant differences between the House and Senate versions of the bill, some similarities exist. Overall, conservation program funding are likely to increase. Other new programs which help facilitate the implementation of conservations systems are also in both versions, including a low interest conservation loan program. This program will provide another means for producers to access scarce capital for implementing conservation systems that achieve compliance with many of the regulations discussed, including the Clean Air and Clean Water Acts, CERCLA and FIFRA.

3.10.4 Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) & Food Quality Protection Act (FQPA)

The primary focus of FIFRA was to provide federal control of pesticide distribution, sale, and use. EPA was given authority under FIFRA not only to study the consequences of pesticide usage but also to require users (farmers, utility companies, and others) to register when purchasing pesticides. Through later amendments to the law, users also must take exams for certification as applicators of pesticides. All pesticides used in the U.S. must be registered (licensed) by EPA. Registration assures that pesticides will be properly labeled and, if in accordance with specifications, will not cause unreasonable harm to the environment. The FQPA amended the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food Drug, and Cosmetic Act (FFDCA) by fundamentally changing the way EPA regulates pesticides, such as requiring risk assessments. Any costs to producers incurred would be either absorbed in contracting fees, or through short-courses offered through the certification by state agencies.

3.10.5 Hormones and Beta-agonists (FSIS Program)

USDA's Food Safety and Inspection Service oversees this program. USDA maintains that these products are equivalent to other products that have been produced without hormones or beta-antagonists. Examples of this inlcude the production of rBST milk and GMO corn. However, there are local societal attempts to differentiate these products, and sell as organic or naturally grown or "BST" or "GMO"-free products. Product differentiation could result in higher revenues to those producers.

3.10.6 Animal Welfare Act (AWA)

The AWA regulates the care and treatment of warmblooded animals, except those, such as farm animals, used for food, fiber, or other agricultural purposes. More information can be found at: http://www.nal.usda.gov/awic/legislat/usdaleg1.htm and at: http://www.aphis.usda.gov/ac/publications.html. This act excludes animals in an agricultural production system.

4 The Case of Feedlot Cattle

The United States is the largest producer of feedlot cattle in the world (Economic Research Service, USDA). The structure of the U.S. cattle feedlot industry has undergone considerable consolidation over the years. Starting in the 1970s, the cattle feeding industry has expanded geographically from being concentrated in the Midwest to the southern plains states. The largest cattle feeding states are Texas, Kansas, Nebraska, and Colorado. As can be seen in Table 7, these four states currently account for almost three-quarters of the U.S. total annual beef production.

In 1980, small farm feedlots with fewer than 1,000 head accounted for 25 percent of fed cattle sold in the country. However, in 1997 these feedlots made up only 15 percent of the fed cattle sold. At the same time, the share of cattle in medium (capacity for 16,000 to 31,999 head) and large (capacity for at least 32,000 head) commercial feedlots increased from 43 percent in 1980 to nearly 60 percent in 1997. Large commercial feedlots experienced the largest increase in share, accounting for 35 percent of cattle on feed in 1999 as compared with only 22 percent in 1980[5].

As with most of the other U.S. agricultural sectors, the regulations regarding beef production are mostly focused on environmental quality. This analysis has estimated the costs of compliance with regulations concerning air and water quality, as well as food safety, focused on Bovine Spongiform Encephalopathy (BSE). BSE regulations were particularly costly for the meat by-products industry, due to resulting restrictions on animal-based feed ingredients.

The sections below discuss the compliance costs associated with the Clean Air Act and Clean Water Act, as well as a discussion of costs related to compliance with BSE prevention regulations. The focus of the analysis is Texas, as it is by far the largest producer of beef in the U.S.

4.1 Clean Air Act Regulations

Feed lot operations typically encompass large areas that can create significant particulate matter in the air. As such, areas of "non-attainment" or non-compliance with Clean Air Act requirements for air quality are not uncommon. Any feedlot owner/operator who plans to construct any new facility or to engage in the modification of any existing facility in Texas, which may emit air contaminants must obtain a permit prior to construction. In addition, any feedlots within non-attainment areas are required to implement Best Available Control Technology (BACT) on their operations. There are two components for treatment that are typically used to meet air quality regulations. These include more frequent manure scraping of manure and bedding and removal from the pens and sprinkler systems to keep dust levels down.

Instead of scraping manure annually, new treatments to assure compliance with air quality regulations required scraping about 3 to 4 times a year.[6] Costs (primarily labor) associated the

[5] http://www.answers.com/topic/beef-cattle-feedlots?cat=biz-fin

[6] Manure Harvesting Frequency—The Key to Feedyard Dust Control in a Summer Drought

additional activities necessary to comply with these regulations are estimated to run between $150 and $250/pen-acre[5]. With an average of 290 head per acre, the costs associated with complying with these regulations average between $.60 and $1.00 per head.

Once the manure pack was stacked, sprinkler systems were installed to reduce dust from the stacks. Average sprinkler costs are $20/head and have a life of 10 years. Operating and input costs run about 20% of fixed costs ($4/head). Using an average of 9.46% interest (consistent with Table 8 assumptions), the average annual fixed cost would be $3.18/head.

The average size for a beef animal in a Texas feedlot is between 800 and 850 pounds (Weinheimer). For the purposes of this analysis, we assume the midpoints of 825 pounds and $.80 per head for scraping costs. These numbers were used to estimate the per head compliance costs with Clean Air Act regulations. Therefore, the total cost for air quality compliance is estimated to be $3.98/head, or $.88/cwt. gain (Table 10).

4.2 Clean Water Act - Comprehensive Nutrient Management Planning (CNMP) Regulations

The primary manifestation of environmental regulations for livestock agriculture in the U.S. is the requirement to develop and follow a Comprehensive Nutrient Management Plan (CNMP) in order to comply with the Environmental Protection Agency's Clean Water Act regulatory requirements. The United States Department of Agriculture (USDA) has estimated the costs for developing a successful CNMP. These estimated costs are presented in Table 8 above. The fattened cattle CNMP costs presented in Table 8 are an average cost of all cattle feedlot operations in the U.S. and are presented on an animal unit (AU) basis (equal to 454 kgs of live weight). Because many of the costs associated with compliance require capital investments in farm infrastructure (e.g. manure stacking facilities), herd size and additional factors will impact individual farm costs. However, in Texas cattle feeding operations are generally quite large, as shown in Table 8, which indicate that economies of scale are likely to be present in the costs of compliance. Therefore, the USDA national compliance costs were modified to reflect the much larger cattle feeding operations found in that state. The procedure used to estimate typical Texas cattle feedlot CNMP costs are discussed in more detail below.
Since no Texas-specific CNMP cost data are available for this example, the USDA estimates were used. Overall, CNMP costs for cattle feedlots, at $14 per AU, are lower than for all other confined livestock types (Table 8). Because of the limited number of feedlots and relative industry consolidation as compared to other agricultural sectors, large cattle feedlot budgets are considered proprietary and difficult to obtain. Therefore, for this analysis, the CNMP compliance costs per AU were constructed for the average size of large Texas feedlots. Table 9 shows that the average size for actual Texas feedlots over 1,000 head is 22,462 head per operation.

A typical budget for a Texas feedlot operation with a 50,000 head carrying capacity was obtained from a USDA simulation model. The CNMP costs were then adjusted from a per-animal unit basis to a per-cow basis (using 1.21 head per animal unit, based on the average

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Brent W.Auvermann, David B. Parker and John M. Sweeten, Texas Agricultural Extension Service, Publication E-52.

live weight of 825 lbs per head). This is consistent with the Texas Cattle Feeder's Association financial data.
Table 8 provides average CNMP compliance costs per AU for large, medium, and small farms for all livestock types, as well as the average costs for fattened cattle at $14 per AU. USDA data indicate that the average U.S. fattened cattle operation is 1,298 head. Therefore, the average Texas feedlot with 22,462 head (
Table 9) would certainly be considered a large fattened cattle operation on a national scale.

Because the average CNMP compliance costs decrease as farm size increases, the estimated costs of $14 per AU for all U.S. feedlots would overestimate the total costs for the larger feedlots typical of Texas. To account for the lower CNMP costs associated with larger feedlots, an adjustment factor was calculated, in an identical fashion to that used in the dairy case above. To estimate the decreasing costs on large feedlots the adjustment factor was obtained by dividing the $21/AU average annual costs for all U.S. large livestock farms by the $39 average annual costs for all U.S. medium livestock farms in Table 2. This results in an adjustment factor of .538. When applied to the $14 per AU cost for a typical US fattened cattle operation, the resulting CNMP compliance cost is estimated to be $7.53 per AU (or $6.21 per head) for a typical Texas feedlot.

Based on the average feeder cattle production estimates on Texas feedlots (50,000 head, assumed 450 pound increase in finishing size[7]), the $6.21 CNMP compliance costs result in a cost per cwt of beef produced of $1.38. As shown in Table 10, this compliance cost accounts for an estimated 0.55% increase in total feedlot production costs.

Table 9: Distribution of Texas feedlots by size category, 2006

Size Category	# of Operations	Total Head	Average Size
1,000 - 3,999	11	13	1,182
4000 - 15,999	38	247	6,500
16,000-31,999	32	560	17,500
32,000+ Head	49	2,100	42,857
Total 1,000+ Head Feed Lots	130	2,920	22,462

Source: USDA National Agricultural Statistics Service

4.3 Food Safety Regulations

Bovine Spongiform Encephalopathy (BSE)

In 2004, USDA, the Food Safety and Inspection Service, and the U.S. Department of Health and Human Services, Food and Drug Administration (FDA) published new rules enhancing

[7] Phone conversation with Ken Mathews, ERS. 9/06/2007.

its BSE safeguards for human food (including dietary supplements) and by-product use in cosmetics, in order to better protect public health[8]. These measures included:

1) Specified Risk Materials (SRM) that are known to harbor the highest concentrations of the infectious agent for BSE, such as the brain, skull, eyes, and spinal cord of cattle 30 months or older, and a portion of the small intestine and tonsils from all cattle, regardless of their age or health;
2) Banning mechanically separated beef which may contain SRMs and instituting strict process controls for establishments using advanced meat recovery (AMR) systems for cattle younger than 30 months of age since SRMs are prohibited from use in AMR systems;
3) Banning any material from nonambulatory ("downer" and/or "dead") cattle;
4) Holding the carcass of any animal chosen for testing out of the food supply until the test is confirmed negative and;
5) Prohibiting air injection stunning of cattle[9]

The FDA later announced additional measures (October 2005) that proposed to prohibit the use of certain cattle origin materials in the food or feed of all animals[10] . The feed ban was instituted by the U.S. Department of Health and Human Services, Food and Drug Administration to help minimize the risk that a cow might consume feed contaminated with the agent thought to cause BSE.

By-products have traditionally been an important source of income for the beef industry, and any decline in price has a direct impact on cattle producers and feeders. Many products are processed from beef by-products, including soaps, pet and livestock feed, fertilizers, gelatin and collagen, which are used extensively in the cosmetic and pharmaceutical industries, and other products used in the manufacture of fatty acids, paints, varnishes, rubber goods, plastics, and lubricants. The additional costs from increased regulations of by-products accrue to these industries and their upstream suppliers of intermediate by-products and offal.

A large portion of animal by-products and rendered products - lard and tallow in particular - have traditionally been sold to foreign markets. BSE restrictions reduced the uses of these products, resulting in additional costs for disposal of SRMs affected by regulations imposed to stop the spread of BSE. Export of beef by-products has declined about 26%, and decreased prices by 20% between 2003 and 2005, due mostly to the decline in exports of meat and bone meal.

Prior to the implementation of BSE regulations, cattle feeders typically received a payment for their dead cattle by the rendering operation. Due to the decline in marketability of rendered beef products, renderers now charge for disposing of deceased cattle in a feeding operation. Typical rendering charges for dead cattle run $25/animal[11]. With an assumed 1%

[8] Mathews, Kenneth H. Jr., Monte Vandeveer, and Ronald A. Gustafson. An Economic Chronology of Bovine Spongiform Encephalopathy in North America. June 2006. LDP-M-143-01. http://www.ers.usda.gov/publications/ldp/2006/06Jun/ldpm14301/ldpm14301.pdf

[9] www.fsis.usda.gov/oa/news/ 2004/bseregs.htm

[10] www.fda.gov/OHRMS/DOCKETS/98fr/05-20196.pdf

[11] Phone conversation with Ben Weinheimer, Vice President, Texas Cattle Feeders Association. 9/12/2007.

mortality (Table 10), this calculates into a $0.25 cost per head that can be attributed to the feedlot operation.

Table 10: Estimated expenses and compliance costs for Texas feedlot, 2007

Expenses:	$ per head	% of total costs
750 lb. feeder steer	814.73	
Total feed, handling, and management charge	257.52	
Interest on feeder and 1/2 feed	44.63	
Death loss (1% of purchase)	8.15	
Total Expenses	1125.03	
Complaince Costs:		
BSE costs (renderer disposal cost) 1/	0.25	0.02%
EPA Clean Air Act costs	3.98	0.35%
CAFO CNMP costs	6.21	0.55%
Total Compliance Costs	10.44	0.93%

1/ Costs associated with BSE rendering restrictions (Ben Wienheimer, Texas Cattle Feeders Association) (@$25/head, 1% mortality=$0.25/head average
2/ Cattle sold f.o.b., 4% shrink.
3/ Steers, 1100-1300 lb, Texas-Oklahoma direct.
4/ Assume 450 lbs gain/head
5/ Texas, North of the Canadian River, "Grain and Feed Weekly Summary and Statistics," AMS
6/ Texas, "Agricultural Prices," National Agricultural Statistics Service
7/ Fixed interest rate, feeder cattle, 11th District Federal Reserve.
Budget Contact: Ken Mathews, USDA ERS.

5 The Case of the U.S. Swine Industry

The structure of the U.S. pork industry has changed markedly in the last several years. Although inventory dropped in the late 1990's, it has risen steadily since then to its present high of almost 63 million head (Figure 1). What is most remarkable is the steady decrease in the number of operations, which has decreased to roughly one tenth the number of operations twenty-five years ago (Figure 2). The recent trend toward increasingly large hog operations has resulted in just 2.5% of the operations (those with greater than 5,000 hogs) controlling 54% of the hog inventory in the U.S. (Figure 3). Although almost 40% of U.S. hog operations have less than 99 hogs, these operations only account for 1% of the hog inventory.

Figure 1: US. Quarterly hogs and pigs inventory

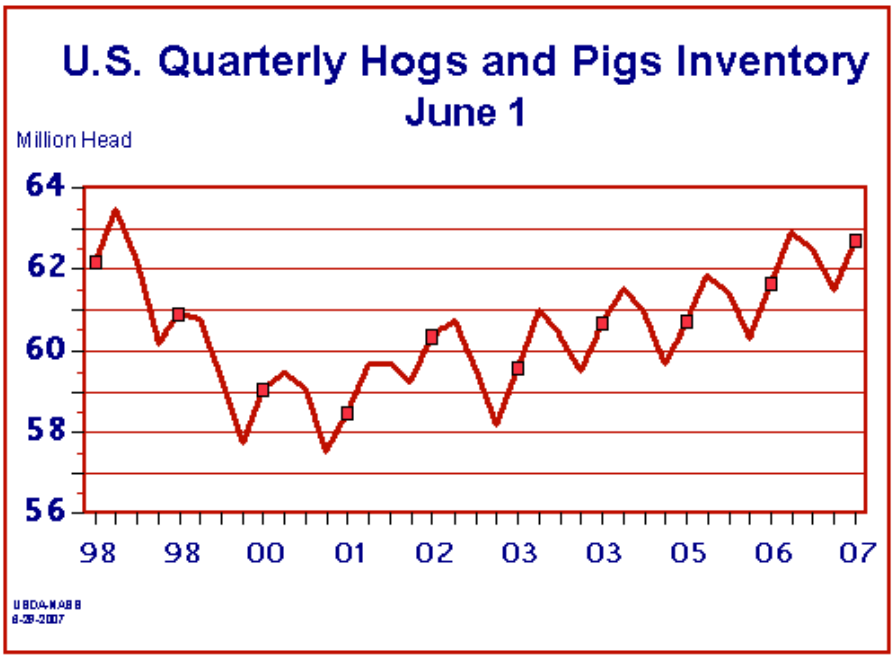


Figure 2: Number of Hog Operations in United States, 2006

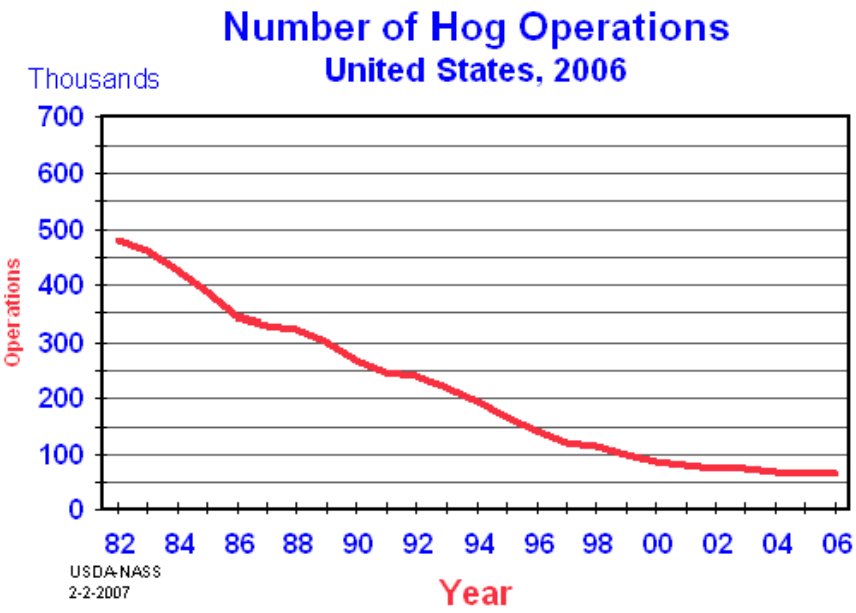
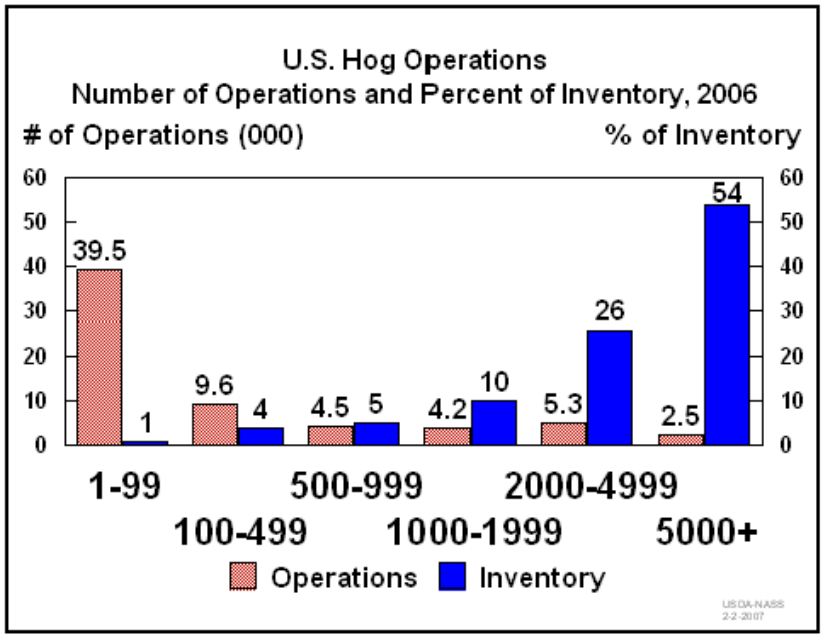


Figure 3: U.S. Hog Operations Number of Operations and Percent of Inventory, 2006



Vertical integration is common in the US swine industry, which has experienced the fastest rate of growth of CAFOs, along with the poultry sector. Map **2** shows that the greatest concentration of swine exist in the Northcentral states, lead by Iowa and Minnesota, as well as in North Carolina, where recent breaches of large manure lagoons have caused serious environmental concerns. Air quality and odour control have become important issues facing large-scale hog production in many regions of the country. The top five pork producing states produce more than 60% of the nation's pork supply (Table 6). Iowa ranks number one in pork production in the United States with a total of 17.8 million hogs and pigs, or 22% of U.S. production in 2004. In 2005 Iowa's hog production represented about $4.3 billion in cash receipts[12].

5.1 The Clean Water Act - Regulations in the Iowa Swine Industry

This analysis has estimated the costs of compliance with regulations concerning water quality for hog farms typical of Iowa. This state was chosen because it is the leading hog producing state in the U.S. Iowa's hog farms represent a more modern, confined feeding operation found in increasing numbers in the top hog producing states. The average hog operation size in this region of the country is approximately 4,300 head. This is well above the threshold size to be considered a Concentrated Animal Feeding Operation (CAFO) according to the Clean Water Act.

The primary manifestation of environmental regulations for livestock agriculture in the U.S. is the requirement to develop and follow a Comprehensive Nutrient Management Plan (CNMP) in order to comply with the Environmental Protection Agency's Clean Water Act regulatory requirements. The United States Department of Agriculture (USDA) has estimated the costs for developing and implementing a successful CNMP. Documentation of these costs is shown in Table 8 above.

The CNMP costs associated with swine operations, presented in Table 8, are an average cost of all swine farms in the U.S. and are presented per animal unit (AU), which is equivalent to 454 kgs of live weight. Because many of the costs associated with CNMP compliance require capital investments in farm infrastructure (e.g. manure storage facilities), the number of AUs over which such investment costs can be spread will have an important impact the compliance costs incurred by individual farms.

This analysis attempted to secure actual CNMP cost data specific to Iowa, but this was not available. Therefore, the national estimates for the CNMP cost for swine operations (Table 8) were adjusted from a per AU basis (US$44) to a per 45.4 kg of gain basis (US$1.57) to be consistent with the available financial data for swine operations.

A typical Iowa swine operation produces two cycles of market hogs, or 'turns', per year. This implies that, on average, it takes 6 months to raise a typical market hog from feeder pig to market. Therefore, at any one time there is only half the number of a farm's total marketed hog capacity on the farm. Feeder pigs generally enter the operation at 50 pounds in weight

[12] 2005 Livestock Summary, NASS Statistical Bulletin.
http://www.nass.usda.gov/Statistics_by_State/Iowa/Publications/Annual_Statistical_Bulletin/2006/06_76.pdf

and leave the operation at 250 pounds. Therefore, over the life of the pig the average weight is 150 pounds and 1 AU equals 6.67 pigs.

Using the national average cost per AU for CNMP implementation of US$44, the average cost per 45.4 kgs of gain is estimated to be US$1.65. This is calculated by multiplying the average weight gain per pig of 90.9 kgs by 6.67 pigs by 2 turns per year, which results in a weight gain of 1,210 kgs (or 2,666 lbs) of gain per AU. This cost of compliance translates into a 3.54% increase in total production costs or a 4.23% increase in direct costs.

Table 11: Production costs for a swine operation typical of the Heartland region, 2005

Direct (Operating) Costs:	US$ per 45.4kg of gain
Grain	1.73
Protein sources	1.34
Complete mixes	10.8
Other feed items 1/	0.07
Feeder pigs	21.32
Hired labor	0.52
Veterinary and medicine	0.58
Bedding and litter	0.01
Marketing	0.47
Custom services	0.25
Fuel, lube, and electricity	0.82
Repairs	0.48
Interest on operating capital	0.64
Total operating costs	39.03
Allocated Overhead Costs:	
Opportunity cost of unpaid labor	2.19
Capital recovery of machinery and equipment 2/	4.27
Opportunity cost of land (rental rate)	0.02
Taxes and insurance	0.38
General farm overhead	0.78
Total overhead costs	7.64
Total Costs	46.67
Annual CNMP Cost 3/	1.65
Percentage of direct costs	4.23%
Percentage of total costs	3.54%

1/ Milk replacer, milk, milk by-products, antibiotics, and other medicated additives.

2/ Machinery and equipment, and housing, manure handling, and feed storage structures, and breeding herd.

3/ Annual costs based upon farm capacity = 2 'turns'/year (.5 number of annual market hogs), $44/animal unit/yr., 6.667 feeder pigs (avg wt 150 lbs)/AU (table 38, pg 105, Cost & Capability study) These costs are already incorporated into ARMS costs and returns surveys (per discussion with Bill McBride, ERS),

Source: USDA-ERS ARMS Financial Data.

6 The Case of Fruits and Vegetables: Florida Citrus and California Tomatoes

The fruit and vegetable industry accounts for nearly a third of crop cash receipts and a fifth of agricultural exports in the United States[13]. In terms of per capita consumption expressed on a fresh-weight basis, the top five vegetables are potatoes, tomatoes, lettuce, sweet corn, and onions while the top five fruit include oranges, grapes (including wine grapes), apples, bananas, and pineapples.

6.1 Methyl Bromide Regulations

Methyl bromide (MeBr) is an odorless, colorless gas that has been used as an agricultural soil and structural fumigant to control a wide variety of pests. However, because MeBr depletes the stratospheric ozone layer and is classified as a Class I ozone-depleting substance, and pursuant to our obligations under the *Montreal Protocol on Substances that Deplete the Ozone Layer* and the Clean Air Act (CAA), the amount of MeBr produced and imported in the U.S. was incrementally reduced until the phaseout took effect on January 1, 2005, except for allowable exemptions.[14]

6.2 Planting Restrictions

The 1990 farm bill instituted a planting flexibility provision that allows commodity crop growers to plant crops other than commodity program crops on their base acreage (acreage used to calculate commodity crop program support) without losing any base acreage or government payments.[15] The fruit and vegetable industry was concerned that base acreage for crop production would be converted to fruit and vegetable production and this would disadvantage current fruit and vegetable producers who do not participate in commodity programs.

Fruit and vegetable producers groups successfully lobbied for a provision to prohibit the planting of fruit and vegetable crops on these “flexed acres”. This essentially limits the use of any acreage receiving commodity program payments from producing fruits and vegetables. This restriction provision has potential impacts on WTO "green box" trade compliance and

[13] Lucier, Gary, Susan Pollack, Mir Ali, and Agnes Perez, *Fruit and Vegetable Backgrounder.* April, 2006. USDA ERS. VGS-313-01. http://www.ers.usda.gov/publications/VGS/apr06/vgs31301/vgs31301.pdf

[14] The Phaseout of Methyl Bromide, Ozone Depletion Rules and Regulations. EPA informational website: http://www.epa.gov/ozone/mbr/

[15] Pollack, Susan L. *More Land But Fewer Farms Dedicated to Fruit Production in 1997.* Fruit and TreeNut Situation and Outlook No. FTS- 285. U.S. Department of Agriculture, Economic Research Service. September 2000. www.ers.usda.gov/briefing/fruitandtreenuts/fruitnutpdf/fruitfarm97.pdf

has been challenged. Should these restrictions be removed, it could negatively impact some established fruit and vegetable producer revenues.

Most fruit and vegetable operations require substantial up-front planting costs and significant labor costs. There is also significant market risk. Producers who do not have an existing contract with "sheds" (packer/shipper partnerships) would need to enter the market in the "speculative field" (no contract). This lack of pre-arrangement would mean no guaranteed market for their product if a producer were to enter the industry on a large scale. Although that impact of removing this provision is unknown, it could be argued that the current marketing structure would render this to be negligible.

6.3 The Case of California Fresh Tomatoes

In 2006, California harvested 44% of the Nation's fresh vegetable acreage, producing 48% of our vegetables, accounting for 51% of the nation's total value of production[16]. Tomatoes are the highest-value vegetable crop. Although California ranks first in production of processed tomatoes, it ranks a very close second to Florida for fresh tomatoes. Seasonal production in Florida and California provides the majority of fresh tomatoes for domestic consumption, with California providing fresh tomatoes from June through November, and Florida producing from October through June.

Approximately 15,000 acres of fresh tomatoes and 110,000 acres of processing tomatoes are grown annually in California's southern San Joaquin Valley[17]. Fresno County leads the state in tomato production. Tomato culture is similar for fresh and processed tomatoes, although varieties and harvest practices are distinctly different. Fresh tomatoes are hand harvested at a mature green stage, transported to a packing shed where they are washed, sorted, graded, boxed and exposed to ethylene (a natural ripening hormone found in many fruits such as tomato) to provide uniform ripening conditions.

The State of California's tomato industry must comply with national regulations, such as the methyl bromide phaseout and air quality regulations, as well as regulations particular to California. These state regulations deal primarily with disease and food safety inspection. Methyl bromide use is very localized in the tomato industry. For example, Florida fresh tomato producers use significant amounts of methyl bromide due to the more humid and higher rainfall climatic conditions there. The combination of methyl bromide and chloropicrin has been used extensively on Florida tomatoes to suppress crop pests such as nematodes, diseases/fungi and weeds. In 1992 and 1993, approximately 3,500 to 4,000 metric tons of methyl bromide, approximately 14 percent of the U.S.' total annual methyl bromide consumption (3,500 to 4,000 metric tons), was used on the Florida tomato crop[18] (FASS 1994, SRI 1993, UNEP 1995). It is estimated that in order to comply with the methyl bromide ban,

[16] USDA NASS. Vegetables - 2006 Summary, January 2007, pg 5.
http://usda.mannlib.cornell.edu/usda/current/VegeSumm/VegeSumm-01-26-2007.pdf

[17] U.C. Davis Vegetable Research Information Center, San Joaquin Valley.
http://vric.ucdavis.edu/virtour/sjvalley/sanjoq.htm

[18] Telone® C-17 and Tillam Use on Florida Fresh Market Tomatoes", US EPA
http://www.epa.gov/spdpublc/mbr/casestudies/volume1/telc17ti.html

by switching to what EPA considers an equally effective alternative treatment, would cost Florida tomato producers an additional $56 per acre.

In California some methyl bromide is used in the southern coast region (where there is higher rainfall and humidity), but not regularly used in the Central and San Joaquin Valleys, where a Mediterranean-type climate limits fungal and bacterial disease problems in tomatoes[19].

State assessments are assigned to support the State Standardization Program, which is responsible for enforcement of laws and regulations establishing quality, maturity, standard containers and packs, size, and container marking requirements for fresh fruits and vegetables[20]. State assessments are applied to each commodity on a per unit basis, ranging from one mil ($0.001) per container for mandatory and three mils ($0.003) per container for non-mandatory inspections. For California fresh tomatoes, there are two primary mandatory assessments; one which covers inspection and control for diseases such as curly top virus control, and the other for marketing support, and for inspection for cleanliness and any other state food quality standards.

Curly top is a serious plant virus affecting several hundred varieties of ornamental and commercial crops in California, including tomatoes[21]. California's State Curly Top Virus Control Program's objective is to use integrated pest management techniques to manage the level of curly top virus infection in susceptible crops such as tomatoes. The only known vector of this virus is an introduced and migratory pest known as the sugar beet leafhopper, Circulifer tenellus. Leafhopper populations develop in selected habitats within the San Joaquin, Imperial, Sacramento and Intra coastal Valleys of California as well as migrating into California from contiguous states and Mexico. The program monitors leaf hopper activity and annually treats significant amounts of rangeland and idle agricultural lands to control breeding populations prior to the migration of adult leafhoppers into susceptible crops. The costs of this program are annually assessed to disease-susceptible vegetable, including San Joaquin tomato producers. This costs each tomato producer an average of $1.38 per acre for program implementation.

The California Tomato Commission facilitates the creation and management of research programs to develop improved varieties of tomatoes, an integrated approach to control pests and diseases common to tomatoes, and more efficient cultural practices. In addition, the commission carries out the California tomato industry's development and management of a national and international advertising and promotion program. This, combined with the research program, is designed to enhance the competitiveness of the California tomato industry within the national and international marketplace[22]. Each fresh tomato producer is required to pay an assessment for these activities. For a typical San Joaquin Valley fresh tomato producer, the cost for this assessment is $20.80 per acre.

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[19] Phone conversation with Charles Rivara, President, California Tomato Research Institute, 8/17/2007

[20] California Department of Food and Agriculture Inspection Services regulations: http://www.cdfa.ca.gov/is/regulation.htm#rates

[21] California Department of Food and Agriculture Curly Top Virus: Program Details: http://www.cdfa.ca.gov/phpps/ipc/curlytopvirus/ctv_hp.htm

[22] California Department of Food and Agriculture Tomato Commission http://www.cdfa.ca.gov/mkt/mkt/tomatoComm.html

6.4 The Clean Air Act

California's Central and San Joaquin Valleys, and South Coast are both high production regions for fresh tomatoes. These areas are designated Air Quality non-attainment regions for PM $_{2.5,10}$, and Ozone. Therefore, all farms within these areas must submit plans to their local Air Quality District. Currently, plans must be developed for PM_{10} that document dust control practices, as well as Ozone plans documenting a 20% reduction in nitrogen oxide and volatile organic compounds. By June 2008, these farms will also be required to have completed a $PM_{2.5}$ plan.

Agriculture within the San Joaquin valley has recently been determined to be compliant with EPA's PM_{10} standards. To be compliant with these standards every farm must have developed and met a dust reduction (conservation management) plan, which addresses all on-field activities (pre and post harvest), and "other" activities which include dust control on roads, wind erosion control, equipment yards and staging areas, and diesel engine replacement or conversion. The local Air Districts do random spot-checks to assure that every farm is in compliance with its dust reduction plan. There was a fee assessed to develop and certify these plans. For non-animal feeding operations, the fee schedule is below; a typical San Joaquin Valley fresh tomato producer would most likely be 500 acres or less.

Table 12: Schedule 2: Initial Non-Afo Cmp Application Fee

Size (in acres)	Initial CMP Application Fee
500 acres or less	$120
501 acres to 1,999 acres	$350
2,000 acres or greater	$550

EPA mandates that there must be separate plans for each principal air pollutant not meeting standards within an area. That includes ozone in the San Joaquin Valley. Therefore, farms within this area must also complete an 8-hour Ozone plan by June of 2007 and are required to comply with Tier 3 EPA/ARB off-road engine standards by the year 2015. All farms with calculated NOx and VOC emissions from the agricultural operation is equal to or greater than 12.5 tons/year (about 350 or more contiguous acres) are required to have an air permit[23]. The San Joaquin Valley Air Pollution Control District provides a calculator on its website for each producer to self-determine whether they would need to comply with these regulations. These operations must register their internal combustion engines used for irrigation purposes, and must pay an annual registration fee of a minimum of $74/year/engine[24]. All pre 1996 diesel engines would not meet EPA's Tier 3 level and must be replaced by 2010.

Dust control, especially on farm and field roads, is the largest expense item for a typical San Joaquin Valley fresh tomato farmer to comply with EPA's Clean Air Act PM_{10} regulations. Treatment measures range from daily spraying with water, to spraying a sealant every other

[23] San Joaquin Valley Air Pollution Control District Requirements for Agricultural Operations. http://www.valleyair.org/General_Info/AGLoader.htm

[24] Rule 3020 Permit Fee Schedules: http://www.valleyair.org/rules/currntrules/r3020.pdf

year. Both treatments can be expensive, running about $2/foot, or $10,000 per treated mile of road[25].

A fresh tomato budget was obtained from the University of California Cooperative Extension Service[26]. The budget is based upon a 1200 acre field and row crop farm, of which 200 acres are used in rotation to grow fresh tomatoes. One section is 640 acres, or 1 mile square, therefore this farm would encompass roughly two sections. For purposes of this study, it is reasonable to assume that there would be 3 miles of dirt road needing treatment (one road splitting the two sections, and then one road down the middle of each section equals 3 miles)[27]. The total semi-annual treatment of these roads would be $30,000, or averaging $15,000/year (($10,000/mile x 3 miles)/2 years). Only 200 acres (or 1/6) of the total 1200 acre farm is devoted to fresh tomatoes, therefore only 1/6 of the annual costs could be attributed to the fresh tomato enterprise. This would amount to $2,500/year for PM_{10} regulations cost of compliance for 200 acres of tomato production, or $12.50/acre. Since these costs were not accounted for in the original budget, they were added as and additional cash overhead expense below (rounded to $13).

6.5 The Case of Southwest Florida Citrus

Southwest Florida has become a major citrus production area. In 2004, citrus acreage in Southwest Florida represented over 22.6 percent of total state citrus acreage. Acreage in Southwest Florida increased from 72,480 acres in 1986 to 179,948 acres in 1998 and then decreased to 169,386 acres in 2004. The decline in acreage was primarily due to trees on sour orange rootstock that died from tristeza virus and acreage destroyed in the citrus canker eradication program. Other disease threats that are being monitored by the industry include citrus greening, which causes the production of low quality fruit, yield decline and tree death.

6.5.1 Water Management

While Florida averages 52 inches of rainfall a year. The majority of this rainfall generally occurs during the summer which leaves the state relatively dry for the remainder of the year. For this reason, water management is an extremely important issue throughout the state. There are five water management districts in the state of Florida. Water management districts are responsible for managing and protecting the district's water resources and related environmental systems. The districts utilize planning, permitting and regulation in order to limit water withdrawal in order to protect natural systems that sustain ground water. Agricultural and other users come to the District to obtain water use permits.

Recognizing that urban standards for surface water management permitting were inappropriate for farming, the District developed special provisions for an agricultural exemption letter to satisfy the surface water regulations of an environmental resource permit (ERP). Agricultural water use permits provide the producer with guidelines for water use according to set parameters. Any new or expanding operation must obtain an environmental

[25] Phone conversation with John Beyer, NRCS California State Air Quality Specialist. 8/27/2007.
[26] University of California Cooperative Extension 2000 Sample Costs to Producer Fresh Tomatoes, San Joaquin Valley. http://www.agecon.ucdavis.edu/outreach/crop/cost-studies/2000FreshToms.pdf
[27] Phone conversation with Robert Fry, USDA NRCS California State Agronomist 9/7/2007.

resource permit before changing land use and new permits must be obtained should the land be sold. Certain areas of Florida have additional water use restrictions. The Southern Water Use Caution Area, within the Southwest Florida Water Management District is an example. Florida aquifer water levels have been in decline, and have suffered from increased threat of contaminants such as salinization. Therefore, established BMPs have been developed that help agricultural operations comply with state and local regulations which cover irrigation use, pest management and nutrient management.[28] These costs have already been absorbed into the typical costs for citrus producers.

6.5.2 Disease Control

Two diseases having a major impact on Florida citrus producers include citrus canker and citrus greening. Regular scouting, reporting, certification and eradication programs are currently being implemented on Florida citrus farms.

Citrus canker, originally detected in Florida in 1995, is a bacteria that disfigures, weakens and eventually kills citrus trees. There is no cure for citrus canker. The pathogen causes necrotic lesions on leaves, stems and fruit, and severe infections can cause defoliation, badly blemished fruit, premature fruit drop, twig dieback and general tree decline. Infected or exposed trees (within a 1,900-foot radius, which is about 240 acres and encompasses up to 28,800 trees) had to be uprooted and burned. Canker is a very serious disease that has the potential to destroy all citrus production in Florida. Therefore, citrus producers and doing whatever they can, including following decontamination and sanitation procedures to prevent canker spread. Growers, handlers, caretakers, processors and packinghouses currently spend more than $20 million annually on decontamination.[29] Citrus canker is spread by human exposure, and with spores carried by wind and rain. The 2004-2005 hurricane season spread the infection to the point that it was determined that the eradication program was not able to eradicate canker, therefore new control rules were developed by USDA APHIS. The establishment of citrus canker means the citrus industry could potentially lose more than $200 million per year due to strict prohibition of exporting citrus to canker-free countries and US states that produce citrus[30]. However, citrus used for the processed juice market is not impacted by the new control rules, therefore any citrus originally destined for the fresh fruit market would need to be diverted to the processed juice market. Citrus greening is considered one of the most serious citrus diseases in the world. It is a bacterial disease that greatly reduces production, destroys the economic value of fruit, and can kill trees. There is no cure for citrus greening; infected tree removal is the only known control strategy. Citrus greening has spread through much of southern Florida and is primarily spread by psyllid insects. At this time, there is no regulatory requirement for the control of citrus greening. However, USDA-APHIS issued a federal order that requires host plants of the Asian citrus psyllid to be

[28] FLORIDA GREEN INDUSTRIES - Best Management Practices for Protection of Water Resources in Florida. University of South Florida. http://www.flcitrusmutual.com/content/docs/issues/protectingwaterresources.pdf

[29] Citrus Canker Q&A, Florida Citrus Mutual.
http://www.flcitrusmutual.com/content/interior.asp?section=issues&body=cankerQA.htm

[30] University of Florida IFAS Citrus Canker Extension Program Fact Sheet:
http://canker.ifas.ufl.edu/index.asp?section=resident&page=facts

treated prior to being moved from areas where citrus greening occurs[31]. This has minimal to no impact of processed juice producers.

[31] Citrus Greening: Questions and Answers. APHIS Fact Sheet. Plant Protection and Quarantine, March 2007 http://www.aphis.usda.gov/publications/plant_health/content/printable_version/faq_citrus_greening.pdf

Table 13: Estimated annual per acre costs and returns for a mature, Hamlin orange grove producing for the processed market, Southwest Florida area, 2003-04a[32]

	Item	Description	Amount	
			---- Dollars ----	
I.	Revenue	516 boxes @ $1.53b		789.48
II.	Expenses			
	Weed control			
	Mow middles			
	Chemical mow	3 times per year	22.76	
	General grove work/sprouting, etc.	2 times per year	10.88	
	Herbicide	(2 labor hours per acre)	25.34	
	Spray program		106.54	165.52
	Fertilizer			131.69
	Dolomite			135.33
	Pruning (maintenance)			12.01
	Topping	($275.00/hr. ÷ 10 A/hr.) ÷ 2.5 yrs.	11.00	
	Hedging	($245.00/hr. ÷ 10 A/hr.) ÷ 2 yrs.	12.25	
	Mow brush	($8.52/A ÷ 2 yrs.)	4.26	27.51
	Tree replacement and care	(1 through 3 years)		
	Remove trees	4 trees per acre	18.96	
	Prepare sites and plant resets	Including 4 trees per acre	47.64	
	Supplemental fertilizer, sprout, etc. (Trees 1-3 years)	Including application	36.96	103.56
	Microsprinkler irrigation			152.07
	Drainage ditch annual costs			40.52
	Total grove care expenses			768.21
III.	Management	$4.00 per acre per month[c]		48.00
IV.	Total specified costs[d]			816.21

[32] Muraro, Ronald P., Fritz M. Roka & Robert E. Rouse. Budgeting Costs and Returns for Southwest Florida Citrus Production, 2003-04., Institute of Food and Agricultural Sciences, Food and Resource Economics Department, Florida Agricultural Experiment Station, Florida Cooperative Extension Service, Gainesville, FL. EDIS FE528, http://edis.ifas.ufl.edu/FE528

V. Return (loss) to land, trees, and ownership -26.73

[a] While estimated annual per acre grove costs in Table is representative of a mature Southwest Florida Hamlin orange grove, respectively, grove care costs for specific grove site may differ depending on grove practices performed (e.g., a Temik application would add $109.43 per acre; extensive tree loss due to blight or tristeza may double tree replacement and care costs; truck watering of resets could add another $8.31 per acre).

[b]On-tree price per box is preliminary; assumes price for processed oranges only.

[c]Other methods to estimate a management cost (e.g., 5% of gross sales or 10% of total grove care costs) are used in the industry and vary from situation to situation.

[d]Other cost items not included in budget are ad valorem taxes and interest on grove investment. In addition to these cost items, overhead and administrative costs (e.g., water drainage/district taxes, crop insurance, and other grower assessments) can add up to 12 percent to the total grove care costs. These costs vary from grove to grove.

VI. Break-even price for total grove care expenses

Boxes per acre					Boxes per acre				
350	400	450	500	550	350	400	450	500	550
$ On-tree price per box					$ Delivered-in price per pound solids[e]				
2.19	1.92	1.71	1.54	1.4	0.76	0.71	0.67	0.65	0.62

[e]Assumes 6.0 pounds solids per box and $2.217 pick and haul cost per box (including canker decontamination costs) and Department of Citrus advertising assessment of $0.15 per box.

Part II: Costs of compliance to environmental regulations in CANADA; Case study on cereals

7 National Context

7.1 Introduction

Part II presents the Canadian case, with a focus on cereals. An extensive analysis is made of the role of regulations which are similar (although usually not equivalent) to the EU's cross compliance related standards. In particular attention is paid to the role and functioning of the so-called Best Management Practices, which are interpreted as having a certain equivalence with the EU's GAEC requirements. Since the Canadian philosophy to regulation differs from the one in the EU (the EU applying obligatory legal requirements) in which voluntary participation and different incentive schemes (cost sharing, subsidies, information communication rather than financial punishments) play a role, also the impact of this is further analysed.
This chapter provides a brief overview of characteristics of production and trade of grains and oilseeds in Canada. The country's unique geography and climate as well as population have a major impact on the characteristics of the grains and oilseeds sector. The population of Canada is relatively low (31 million) compared to its total area (10 million km^2). However, only 5% of the total land area is suitable for agriculture, mainly along the border with the United States. 90% of Canadian population is lives within 160 km of the border.

7.2 An Overview of the Main Features of Canadian Grains and Oilseeds Production Regions

7.2.1 Major Growing Areas

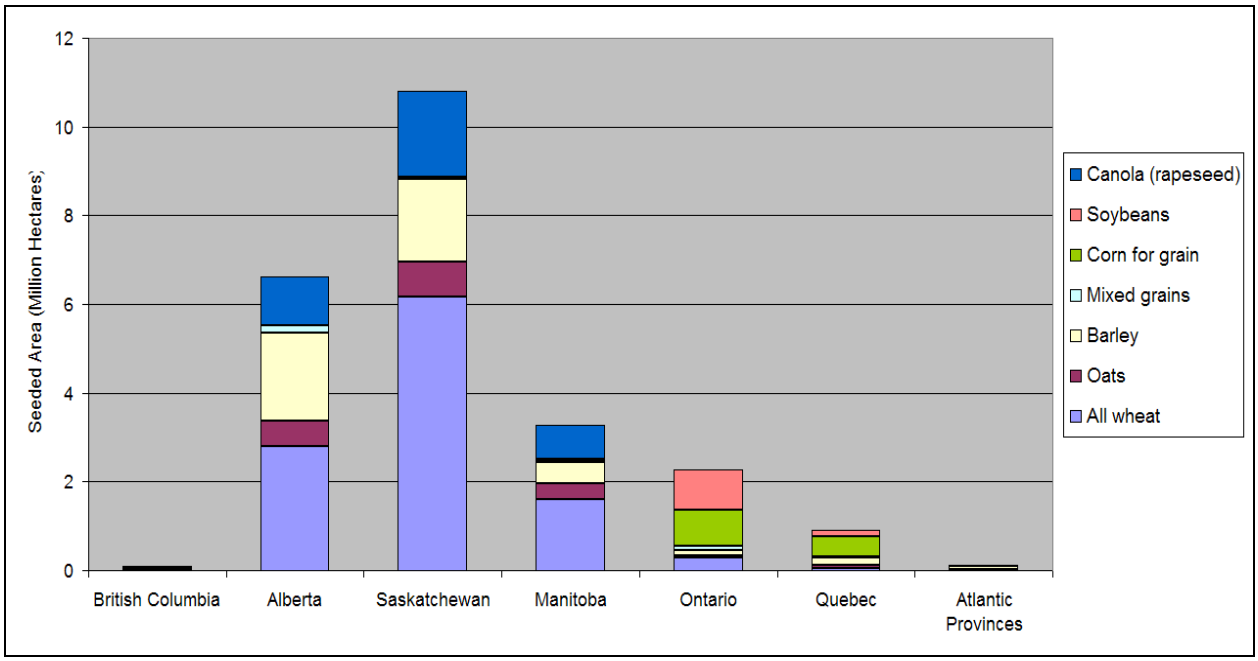
Due to climatic and geographic differences, two distinct regions in Canadian cereals sector can be observed. As indicated in Figure 5 one, smaller region is in Eastern Canada, mainly in Ontario and Quebec, while the other is in Western Canada, covering the Provinces of Manitoba, Saskatchewan and Alberta. These two regions are characterized by specific crops adjusted to the general regional climatic and soil conditions. Southern Ontario and parts of Quebec share common warmer climate and higher precipitation (find a reference – Env. Can.) due the effect of the Great Lakes complex, providing good growing conditions for corn. Thus, these are the main corn growing areas in Canada. Besides corn, winter wheat and soybeans are the other major crops in the region.

The dryer and cooler climate of the Western Provinces, also called The Prairies Provinces, together with flat terrain and deep soils (reference) provide growing conditions for spring wheat, barley, oats and canola. Figure 4 illustrates area seeded by major cereals and oilseeds

in Canada, by province in 2001. In Ontario, corn and soybeans were the most represented, with both at about 800 and 900 thousand hectares seeded respectively. Next is wheat at about 300 thousand hecteres. In total, more than 2 million hectares were seeded with grains and oilseeds in Ontario in 2001. Corn for grain was most seeded in Quebec with about 400 thousand hectares under corn. Barly and soybeans are next at about a third of that. In total, the area seeded in Quebec was about half of the seeded area in Ontario.

Compared to the Prairies Provinces the above mentioned seeded areas are quite small. For example, the area seeded with wheat in Saskatchewan was almost three times the total area of all crops in Ontario and about six times of that in Quebec. The total seeded area in the Prairies Provinces was about 20 million hectares compared to about 3 million in Quebec and Ontario. The main crops, as mentioned earlier were wheat, barley, canola, and oats. Wheat and barley account for more than two thirds of the seeded area, with most wheat seeded in Saskatchewan (about 6 million hectares) and barley in Alberta (about 2 million hectares). Saskatchewan had the largest canola area at about somewhat less than 2 million hectares, followed by Alberta (about 1 million hectares) and Manitoba (0.7 million hectares).

Figure 4: Area seeded by major cereals and oilseeds in Canada, by province, 2001



Source: Statistics Canada

Figure 5: Principal Cereal Growing Areas in Canada



Source: Canadian International Grains Institute, 2004

7.2.2 Farm Number and Size

Table 14 compares numbers of farms and farm operators in Canada, 2001 and 2006. In 2001 there were close to 66 thousand farms producing grains and oilseeds in Canada. By 2006 this number dropped by 8.2% to 60,554. This represents a continuation of a well-documented trend of decrease in the number of farms in Canada in the last several decades. At the same time the number of farm operators dropped by 6.8%, translating into a slight increase in the number of operators per farm. This indicates that besides exiting the industry, some operators might have merged their operations into partnerships. Grains and oilseed farms comprised about 26.7% of total farms in 2001, wile in 2006 their share fell to 24.9, indicating that grains and oilseeds sector has experienced a higher drop in the number of farms than the rest of the agricultural sector. The number of farms growing corn decreased more relative to the other sectors, while the number of farms growing soybeans and other oilseeds increased. This may be partly a reflection of the current year predominant rotation pattern but it could also me a sign of framers switching from corn to soybeans due to more favorable pricing or other conditions.

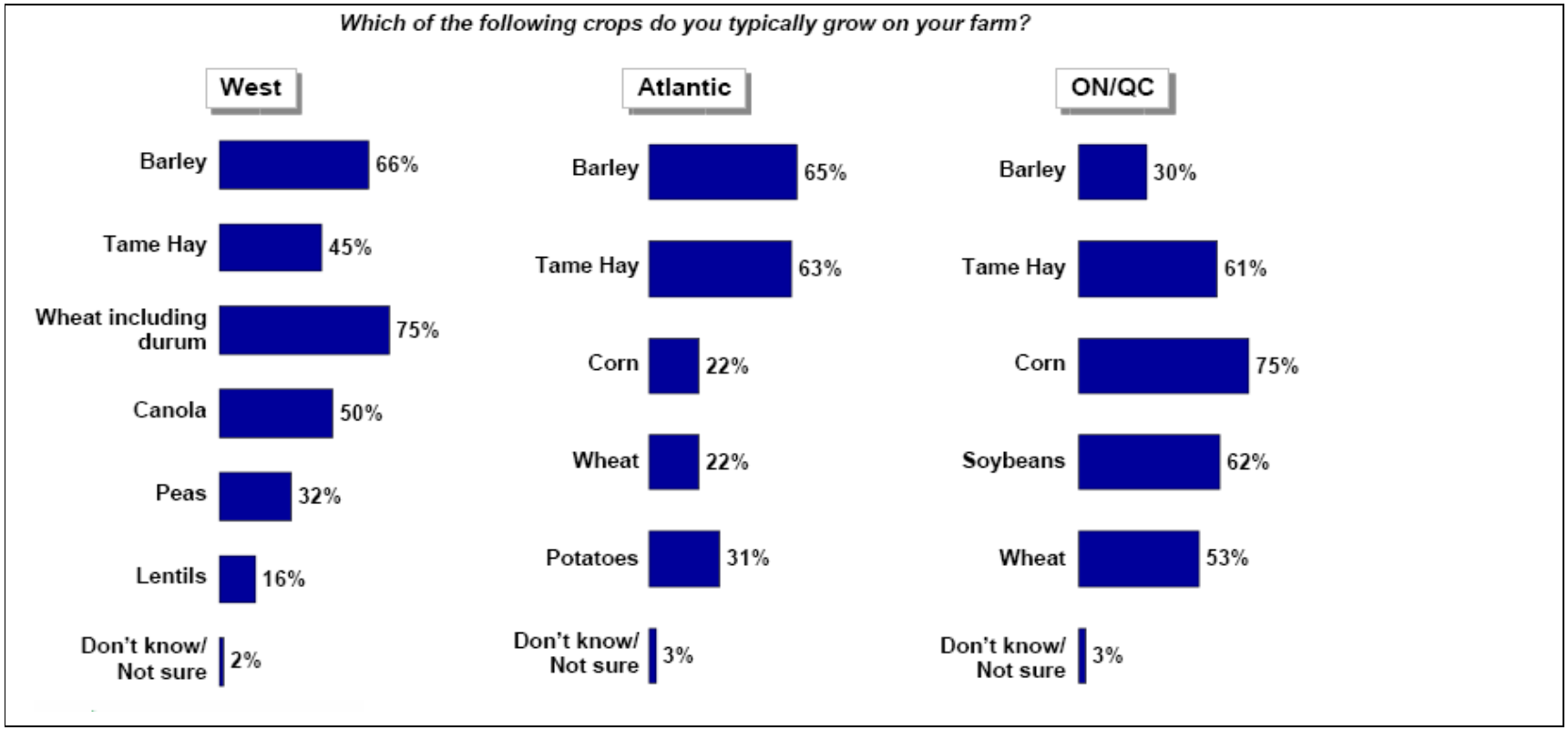
While the number of farms decreased, total farm area as well as area under crops has not changed significantly in the last 20 years, indicating that the average farm size must have increased. Total farm area has been fluctuated between 67.5 thousand and 68 million hectares while the number of farms dropped from 293 thousand in 1986 to somewhat more somewhat more than 229 thousand in 2006. This was reflected in a 27.7% increase in the average farm size between 1986 and 2006 (i.e. from 231 ha to 295 ha). It may be interesting to note that area owned decreased slightly (4.3%) while era rented increased (6.5%). It can not be said, though, that Canadian farmers own less and rent more land than 1986 because both owned

and rented area per farm increased since 1986. However, area rented increased relatively more (29%) than area owned (19%).

With respect to cropland area, there has been an increase both in the total area under crops and in average area per farm. The total area under crops increased from about 33 million hectares to almost 36 million hectares while the average area per farm increased by 46%, almost double of the overall increase for all farms. This indicates that crop farms have experienced a higher degree of consolidation (i.e. increase in size and decrease in number) than livestock farms in Canada.

Table 16 summarizes the number of grain and oilseeds farms in Canada by revenue class between 2001 and 2003. Contrary to the common perception that today's agriculture is dominated by large operations, more than 60% of the farms have gross revenue below $100,000. Furthermore, revenues of more than 85% of Canadian farms in 2003 were less than $250,000. However, the number of farms in the top 2 revenue classes ($250,000 to $500,000 and $500,000 and up) has generally been increasing from 2001 to 2003 while the number of farms in the lower three classes has been decreasing. In 2002 there were 6.1% less farmers with revenues under $250,000 than in the year before. This number decreased further by 5.2% in 2003. At the same time the number of farms with revenues above $250,000 increased by 15% between 2001 and 2003 and by another 9.8% between 2002 and 2003. These numbers indicate that, even though the number of large farm operations is still relatively low, large farms may become dominant, if the current trend in farm numbers continues.

Figure 6: Crops grown by region



Source: Crop Nutrients Council (2006)

Table 14: Numbers of farms and farm operators in Canada 2001 and 2006

	Number of Farms					Number of Farm Operators					Operators per Farm		
	2001		2006			2001		2006			2001	2006	
Farm Type	**Number**	**% of All Farms**	**Number**	**% of All farms**	**% change**	**Number**	**% of All Operators**	**Number**	**% of All Operators**	**% change**	**Number**	**Number**	**% change**
Soybean	5,679	2.3	6,422	2.8	13.1	7,445	2.2	8,390	2.6	12.7	1.31	1.31	-0.3
Oilseed (except soybean)	6,173	2.5	10,322	4.5	67.2	7,795	2.3	13,505	4.1	73.3	1.26	1.31	3.6
Wheat	15,803	6.4	12,157	5.3	-23.1	19,665	5.7	15,480	4.7	-21.3	1.24	1.27	2.3
Corn	5,432	2.2	3,670	1.6	-32.4	7,280	2.1	4,880	1.5	-33	1.34	1.33	-0.8
Other grain	32,841	13.3	27,984	12.2	-14.8	44,065	12.7	38,145	11.7	-13.4	1.34	1.36	1.6
All Grains and Oilseeds	65,928	26.7	60,554	26.4	-8.2	86250	24.9	80400	24.6	6.8	1.31	1.33	1.5
All Farms	**246,923**		**229,373**		-7.1	**346,195**		**327,055**		**-5.5**	1.40	1.43	1.7

Source Statistics Canada (2007)

Table 15: Total farm area, land tenure and land in crops in Canada, by province (1986 to 2006 Censuses of Agriculture)

	1986	1991	1996	2001	2006	% change 1986 to 2006
Total number of farms	**293,089**	**280,043**	**276,548**	**246,923**	**229,373**	-21.7
Total farm area						
Area in hectares[1]	67,825,757	67,753,700	68,054,956	67,502,446	67,586,739	-0.4
Farms reporting	293,089	280,043	276,548	246,923	229,373	-21.7
Average area in hectares per farm reporting	231	242	246	273	295	27.7
Total area owned						
Area in hectares[1]	43,218,905	42,961,352	43,060,963	42,265,706	41,377,673	-4.3
Farms reporting	273,963	264,837	262,152	235,131	220,513	-19.5
Average area in hectares per farm reporting	158	162	164	180	188	19.0
Total area rented or leased from others[2]						
Area in hectares[1]	24,606,852	24,792,348	24,993,993	25,236,740	26,209,066	6.5
Farms reporting	118,735	111,387	111,718	103,484	97,989	-17.5
Average area in hectares per farm reporting	207	223	224	244	267	29.0
Land in crops (excluding Christmas tree area)						
Area in hectares[1]	33,181,235	33,507,780	34,918,733	36,395,150	35,912,247	8.2
Farms reporting	264,141	248,147	237,760	215,581	194,717	-26.3
Average area in hectares per farm reporting	126	135	147	169	184	46.0

1. Conversion factor: 1 hectare equals 2.471 054 13 acres.
2. Total area rented or leased from others includes land; leased from governments, rented or leased from others and crop-shared from others.
Source: Statistics Canada, censuses of agriculture.

Table 16: Number of grain and oilseeds farms in Canada by revenue class

	2001		2002			2003		
	Number	**% of all G & O farms**	**Number**	**% of all G & O farms**	**% change**	**Number**	**% of all G & O farms**	**% change**
$10,000 to $49,999	35480	41.9	33215	41.3	-6.4	31650	41.0	-4.7
$50,000 to $99,999	17105	20.2	16590	20.6	-3.0	15395	20.0	-7.2
$100,000 to $249,999	21250	25.1	19530	24.3	-8.1	18665	24.2	-4.4
$10.000 to $250,000	**73835**	**87.3**	**69335**	**86.3**	**-6.1**	**65710**	**85.2**	**-5.2**
$250,000 to $499,999	7995	9.5	7785	9.7	-2.6	7935	10.3	1.9
$500,000 and over	2750	3.3	3235	4.0	17.6	3490	4.5	7.9
$250,000 and over	**10745**	**12.7**	**11020**	**13.7**	**15.0**	**11425**	**14.8**	**9.8**

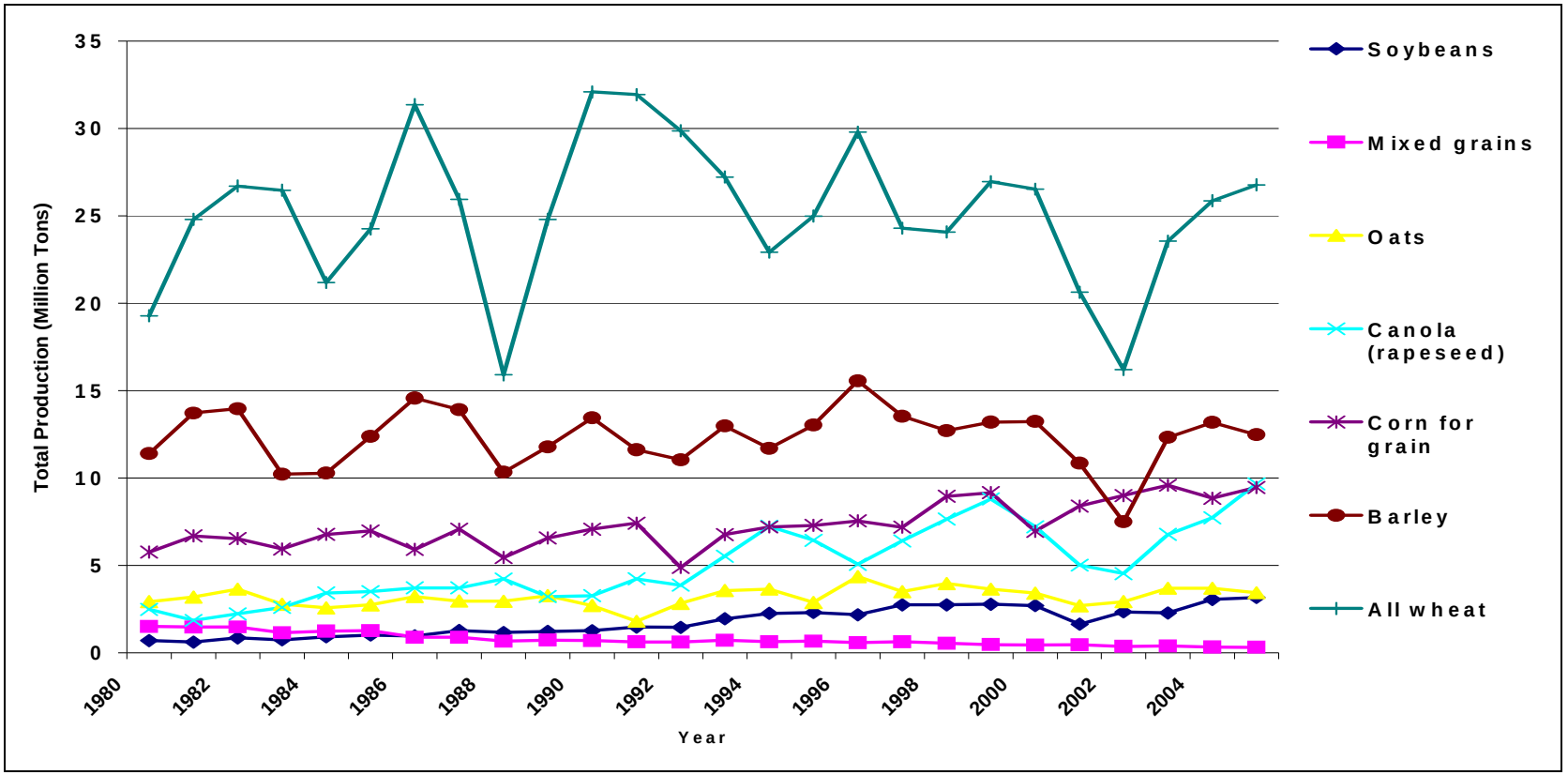
Source: Statistics Canada (2007)

7.2.3 Production and Trade

Figure 7 illustrates production of major cereals and oilseeds in Canada between 1980 and 2005. Wheat is the main cereal crop in Canada. In the last 25 years, its production fluctuated around 25 million metric tons. The last major drop in production was in 2002 due to the 2001-2002 drought, when the production fell to 16 million metric tons (AAFC, 2004). Since then, it has been steadily increasing and in 2005, production reached about 27 million tons.
Barley is the second most produced crop in Canada. The production of barley, for most of the period between1980 and 2005, fluctuated between 10 and 15 million metric tons. Similar to wheat, barley production experienced a significant drop in 2002, when it fell to about 7.5 million metric tons. It rose to about 13 million tons between in 2003 and 2004 and fell slightly in 2005.

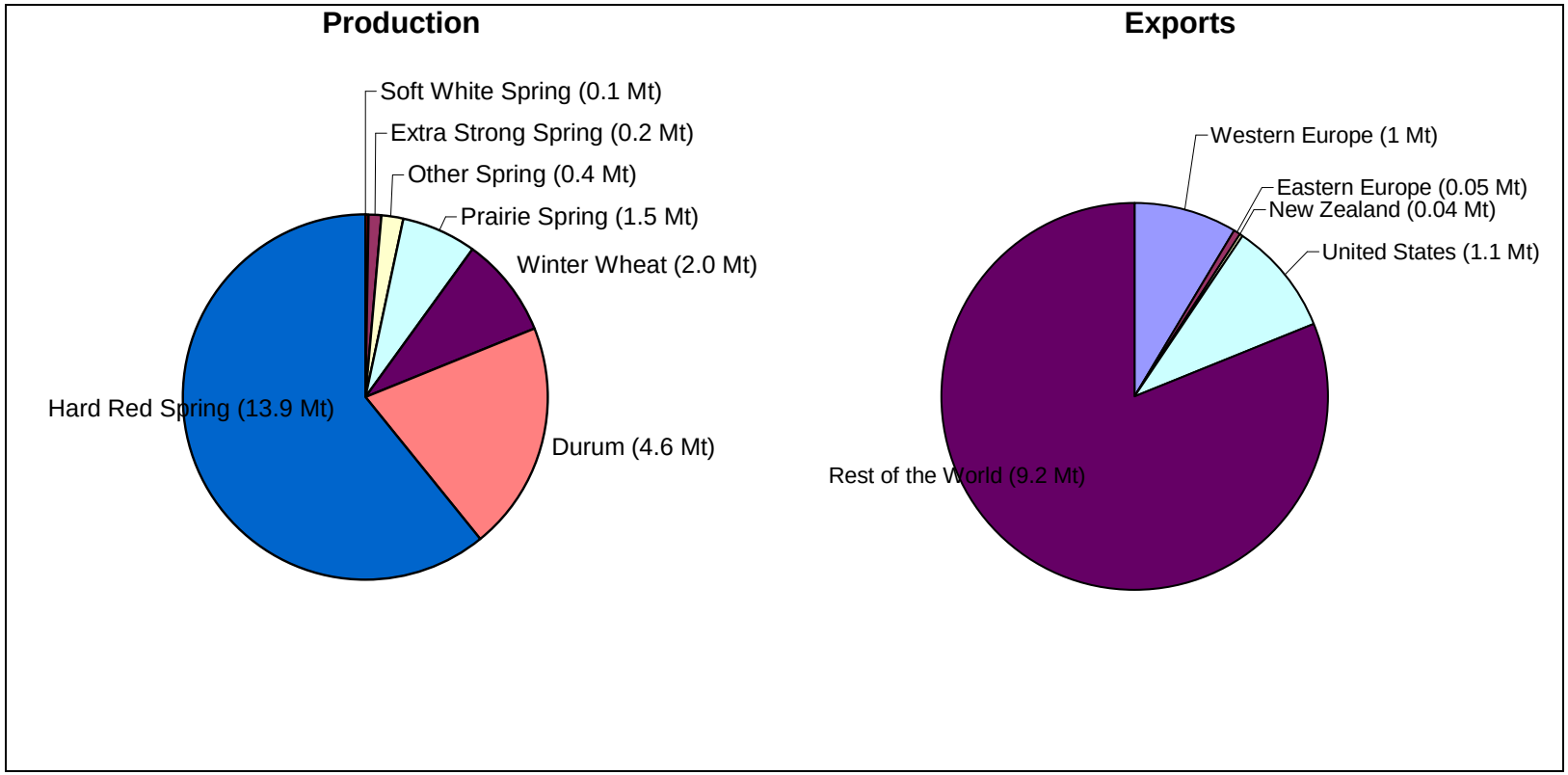
Production-wise, grain corn and canola are the only other two crops whose production is above 5 million tons. While the production of both crops has been increasing in the last two and a half decades, production of canola rose relatively more, especially since 2002, when t doubled from 5 million metric tons in 2002 to about 10 million metric tons in 2005. In 1980, only about 2.5 million metric tons of canola were produced. In 2005 production of corn was at somewhat below 10 million metric tons, which represented about 2.5 metric tons increase from 2002. In 1980, somewhat more than 5 million metric tons of grain corn were produced in Canada, and there has been a moderate increasing trend since then. While about the same amounts of oats and soybeans were produced in 2005 (about 3 million metric tons), production of hasn't risen significantly from the 1980's the production of soybeans rose more than 3 times.

Figure 7: Total Production of major cereals and oilseeds in Canada, 1980-2005



Source: Statistics Canada (2007)

Figure 8: Canadian wheat production and exports by trading partner, 2000 – 2005 average

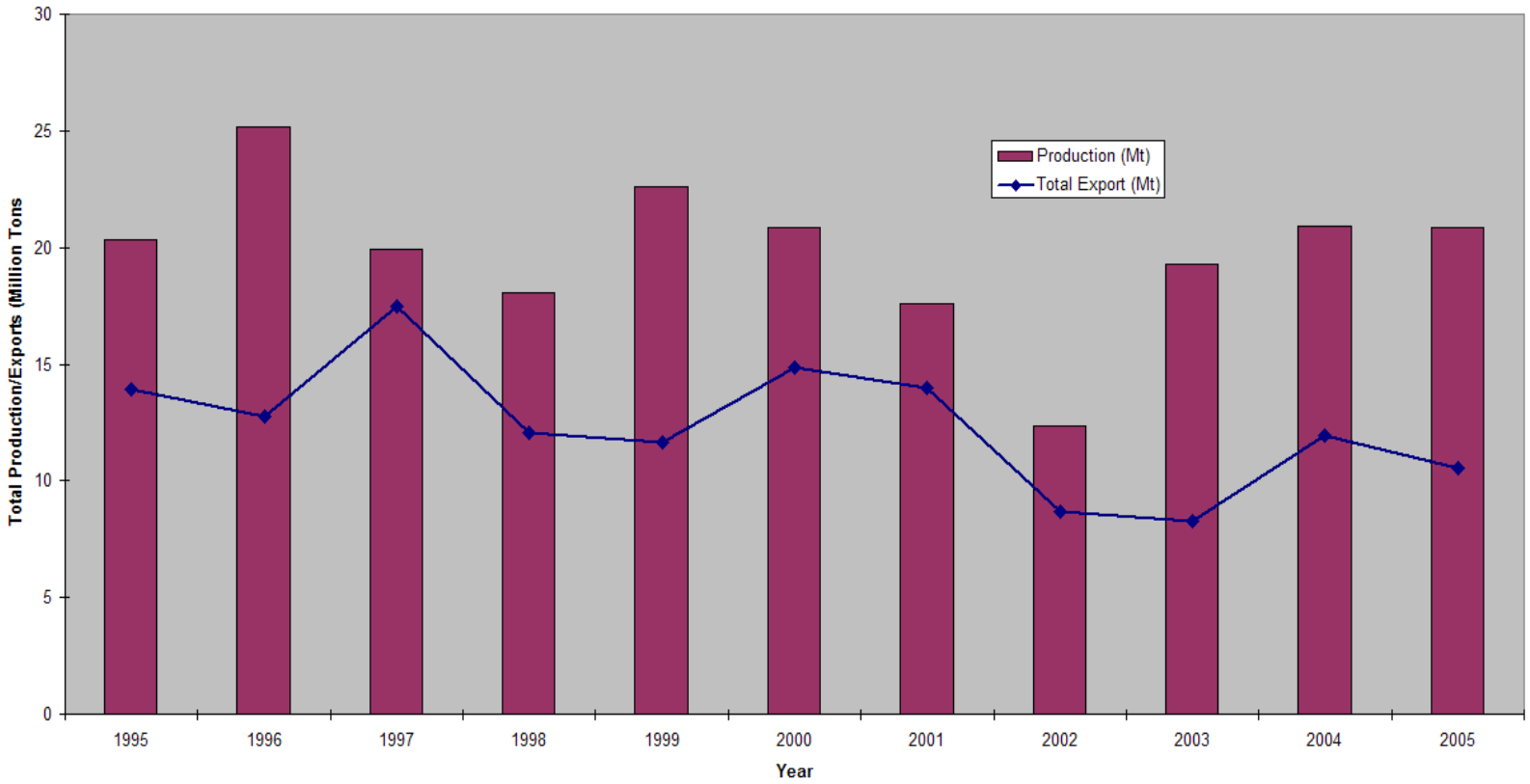


7.2.3.1 Production and Trade of Wheat

Wheat production is concentrated in the Prairie provinces, Saskatchewan is the largest producing province, where 45% of agricultural cash receipts come from wheat (http://www.ag.usask.ca/in_the_community/displays/story/wheat.html University of Saskatchewan, undated). In Eastern Canada, Ontario is the major wheat producing province. Spring wheat is the dominant type of wheat, grown mainly in Saskatchewan, Alberta and Manitoba. The most important variety is Hard Red Spring Wheat (Figure 8), which comprised more than half of the total average annual wheat production between 2000 and 2005. Other varieties are Prairie Spring, Extra Strong Spring, Soft White Spring, and some other varieties of spring wheat. Durum wheat comprised about a fifth of the average annual wheat production in Canada between 2000 and 2001. Winter wheat is grown in Ontario. At 2 million metric tons per year, it represented less than 10% of the total wheat production between 2001 and 2005.

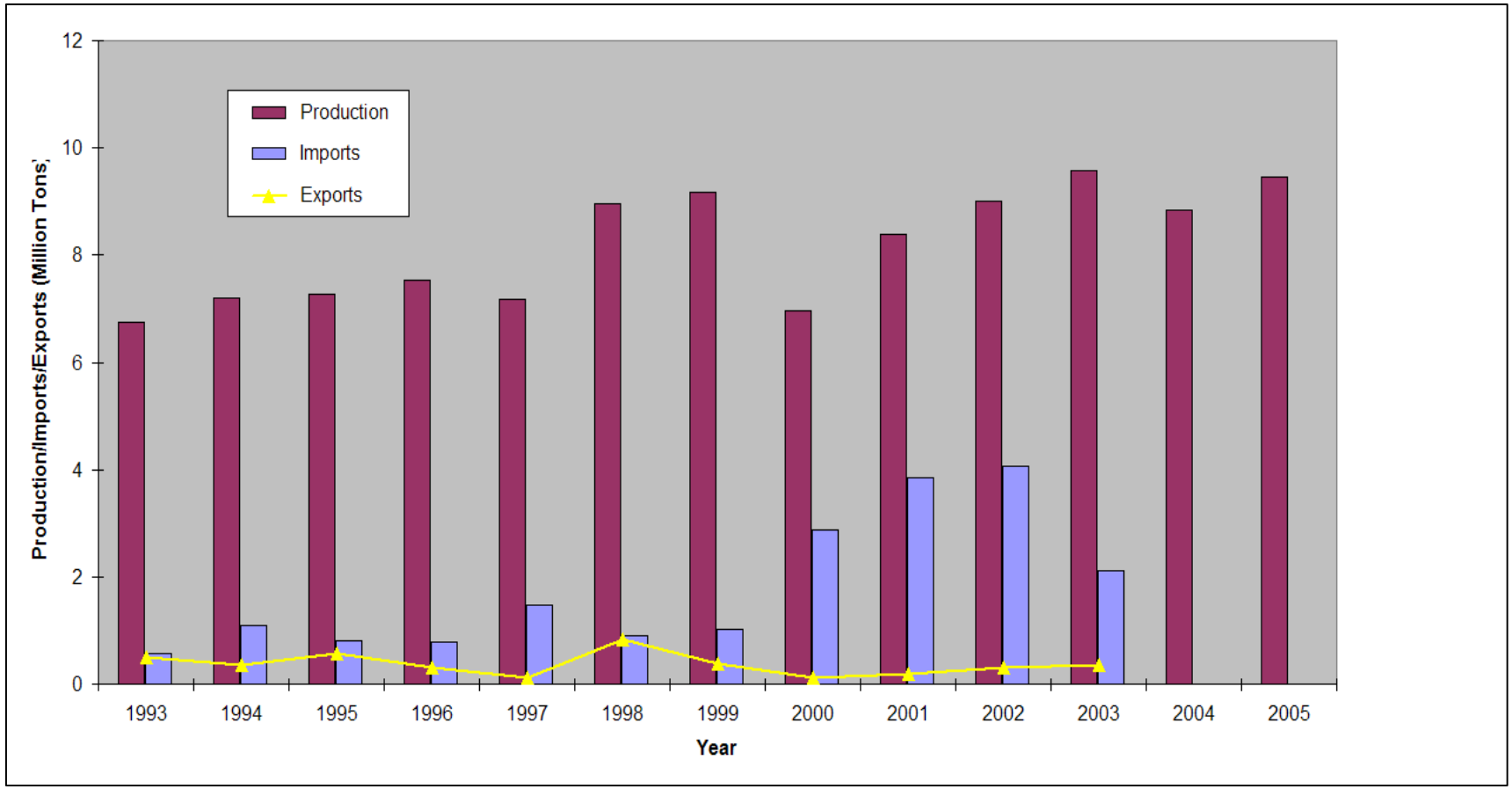
Canada exports wheat to more than 60 different countries. China, the countries of the former U.S.S.R., and Asia are the main importers of Canadian wheat (Reference, find statistics). The partners in this project (E.U., U.S. and New Zealand) comprise less than a quarter of Canadian wheat exports (see Figure 9). Thus, any relative change in competitiveness of Canadian wheat sector compared to the U.S., E.U. and New Zealand is not likely to have a large effect on Canadian exports to these countries. The U.S. is the largest trading partner among the three. Canada exported an average of about 1.1 million metric tons per year to the U.S. over the period 2000 to 2005. Next is Western Europe with 1 million metric tons. Exports to the eastern Europe and new Zealand were almost negligible with about 50 and 40 thousand metric tons per year. Figure 9 shows Canadian wheat production and exports excluding durum wheat, between 1995 and 2005. A slight downward trend in wheat exports is noticeable. For example, only 3 times in the last 10 years wheat exports rose compared to the previous year, as opposed to the other 7 years when exports fell compared to the previous year. In 1995 Canada exported close to 15 million metric tons of wheat. This figure fell to about 10 million metric tons in 2005. Only in 2002 and 2003 were wheat exports lower than this. Wheat production, however, did not fall as much, compared to 1995. In fact, wheat production in 2005 was almost the same as in 1995. This indicates that the share of wheat produced that is being exported has declined over the last 10 years. This may be due to increased domestic use or increased inventories.

Figure 9: Canadian wheat production and exports, 1995 – 2005



Notes:
1) Excluding durum wheat

Figure 10: Production, exports, and imports of grain corn in Canada, 1993 –2005



Notes: Corn imports data not available for 2004 and 2005

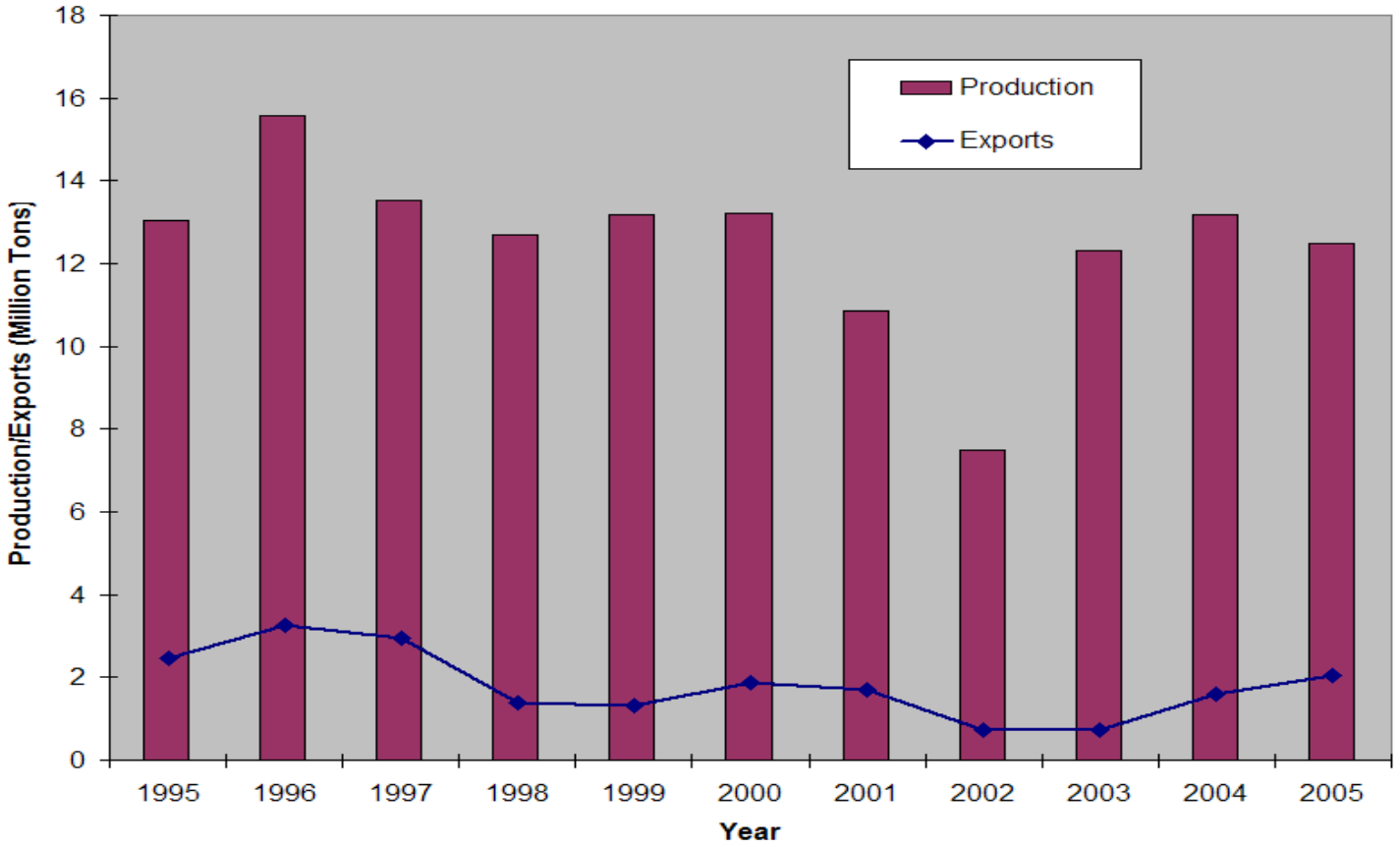
7.2.3.2 Production and Trade of Corn

About two thirds of Canadian corn is grown in Ontario, with one third in Quebec and small amounts in Manitoba, Alberta and Nova Scotia. Only 5 to 10 percent of the corn is exported, mainly to the U.S. Corn imports are somewhat higher, especially after the year 2000. Canadian corn production rose from less than 7 million tons in 1993 to somewhat less than 10 million tons in 2005.

7.2.3.3 Production and Trade of Barley

About one sixth of the barley produced in Canada in 2005 was exported. About one quarter of that was to the U.S. There are only occasional small exports to Europe, Australia and New Zealand. Since 1995, domestic production was most often about 12 to 13 million tons per year, with extremely low production in 2002 due to low yields (drought), and a record high production in 1996 at almost 16 million metric tons. It is evident that, similar to the case of wheat, Canada is self sufficient in barley production but, unlike in the case of wheat, most of the production is being consumed domestically. This, coupled with a negligible portion of export to the E.U. suggests that the impact of a lower cost of production in Canada relative to the E.U. would have a small effect on the European barley sector.

Figure 11: Production, exports, and imports of barley in Canada, 1995 –2005



7.3 Farm-level Production Characteristics

7.3.1 Crop Rotations

The three main crops in Ontario and Quebec – corn, winter wheat and soybeans are usually grown in a three-year rotation. Rotation of crops, is an "agricultural practice of varying the crops on a piece of land in a planned series, to save or increase the mineral or organic content of the soil, to increase crop yields, and to eradicate weeds, insects, and plant diseases. In a rotation, it is often desirable to alternate a cultivated crop (e.g., corn) with a legume (e.g., clover), which adds nitrogen to the soil" (Columbia University Press Encyclopedia, 2007). Similar to there eastern counterparts, western farmers also grow most of their crops in a rotation – a sequence of different crops is being seeded on the same land over a period of several years. Table 17 shows that most farmers grow more than one crop. When asked, in an Iposos-Reid survey in 2006, which crop they typically grow on their farm, most of the western farmers responded wheat (75%). Next were barley and canola with 66% and 50% of farmers growing the two crops respectively. It is evident from these figures that most farmers typically grow more than one crop, be it by dividing a farm between crops in a given year, or rotating different crops across years, or both.

7.3.2 Production Diversification

Even though Canadian farms are becoming larger in size, they are still fairly diversified. As it can be seen in Table 17, 52% of farms in the West, 61% in Atlantic Provinces and 25% in Ontario and Quebec, raise beef cattle alongside with growing field crops. While raising dairy cows together growing field crops is not as common in the western provinces, about a third of the farmers in Atlantic Provinces and in Ontario and Quebec run mixed dairy-field crop operations. Thus, when considering the impact of environmental regulations on Canadian cereal crop producers it is important to assess costs both to the crop and livestock component of a farm.

Table 17: Percent of farms on which other types of production accompanied field crop production in 2006

	Region			
	West	Atlantic	Ontario/Quebec	Total
Beef Cattle	52%	61%	25%	42%
Dairy	4%	31%	35%	15%
Other types of livestock	12%	6%	10%	11%
Pigs	5%	17%	9%	7%
Poultry	6%	2%	8%	7%
Horticulture or Viticulture	2%	13%	5%	3%
Other production (Christmas trees, woodlots, sod, honey, others)	2%	20%	13%	7%
Do not know/Not sure	38%	6%	21%	31%

Source: Crop Nutrient Council (2006)

7.3.3 Cost Structure of Production

Cost structure of production depends on the specific farming system in question. As shown earlier, Eastern and Western Canada are characterized by different crops and farming systems. Main crops in the West are spring wheat, Durum wheat, Barley, Oats, Barley and Flax. In the East Corn, soybeans and winter wheat are the dominant crops, while spring wheat and barley are grown in small amounts.
It is evident that both costs and revenues are generally lower for crops grown in western Canada. For example, seed expenses in 2007 were 2 to 7 times lower in the Western Provinces compared to Ontario. Western farmers spend on seed about $25/ha while farmers in Ontario spend about 4 and a half times as much. Western farmers would on average spend $80/ha on fertilizers for spring wheat while their eastern counterparts would spend more than $110/ha for spring wheat and close to $140/for winter wheat. Similar situation is with barley too. An Ontario farmer spends about $111/ha on fertilizer for barley while a western farmer spends about $80/ha. This difference is even more pronounced for corn. Ontario corm producers' average fertilizer expense was about $207/ha, 2-and-a-half times higher than the fertilizer expense for growing wheat and barley in the Western Provinces. Growing flax or oats in the West is, fertilizer-wise, roughly ten times cheaper than growing any crop in Ontario. These difference are probably a combination of higher prices and higher fertilizer application rates (different crop needs) in the East.

Table 18: Western Canada crop budgets

	Conventionally seeded stubble crops, black soil zone					
	Spring Wheat	Durum Wheat	CPS Wheat	Feed Barley	Oats	Flax
Revenue ($/ha)						
Estimated Yield (ton) (A)	2.451	3.036	3.918	4.639	1.071	2.107
Estimated Market Price/ton (B)	165.4	147.1	95.6	82.7	375.3	159.9
Estimated Gross Revenue/ha (AxB)=(C)	**405.4**	**446.5**	**374.6**	**383.7**	**401.9**	**337.0**
Variable Expenses/hectare						
Seed	24.9	22.2	19.7	31.6	46.8	49.0
Fertilizer						
-Nitrogen	60.9	60.9	60.9	60.9	6.1	6.1
- Phosphorus	20.0	20.0	20.0	20.0	13.4	10.0
- Sulphur & Other	0.0	0.0	0.0	0.0	0.0	0.0
Chemical						
-Herbicides	40.0	40.0	39.9	19.7	87.3	59.7
- Insecticides/Fungicides	5.5	5.5	0.0	0.0	2.7	1.2
- Others	6.7	6.7	5.9	7.6	4.5	8.9
Machinery Operating						
-Fuel	32.2	32.2	32.2	32.2	35.4	35.4
- Repair	14.1	14.1	14.1	14.1	22.3	22.3
Custom Work & Hired Labour	19.2	19.2	14.2	14.2	14.2	12.4
Crop Insurance Premium	11.7	16.6	11.4	14.3	23.3	13.3
Utilities & Miscellaneous	13.1	13.1	13.1	13.1	13.1	13.1
Interest on Variable Expenses	7.1	7.1	6.6	6.5	7.7	6.6
Total Variable Expenses (D)	**255.3**	**257.5**	**238.0**	**234.3**	**276.7**	**238.0**
Other Expenses/acre						
Building Repair	4.0	4.0	4.0	4.0	4.0	4.0
Property Taxes	15.3	15.3	15.3	15.3	15.3	15.3
Insurance & Licenses	5.8	5.8	5.8	5.8	5.8	5.8
Machinery Depreciation	47.0	47.0	47.0	47.0	55.7	55.7
Building Depreciation	4.0	4.0	4.0	4.0	4.0	4.0
Machinery Investment	26.8	26.8	26.8	26.8	31.8	31.8
Building Investment	4.5	4.5	4.5	4.5	4.5	4.5
Land Investment	42.9	42.9	42.9	42.9	42.9	42.9
Total Other Expenses (E)	150.3	150.3	150.3	150.3	163.9	163.9
Labour and Management (F)*						
Total Expenses (D+E+F)=(G) ($/ha)	**405.6**	**407.9**	**388.3**	**384.6**	**440.7**	**401.9**
Total Expenses (D+E+F)=(G) ($/ton)	**165.5**	**134.3**	**99.1**	**82.9**	**411.5**	**190.7**
Summer fallow Total Cost (H)	0.0	0.0	0.0	0.0	0.0	0.0
Total Rotational Expense (G+H)=(I)	405.6	407.9	388.3	384.6	440.7	401.9
Return over Variable Expenses (C-D)	150.1	189.0	136.6	149.5	125.1	99.0
Return over Total Rotational Expenses	**-0.2**	**38.7**	**-13.8**	**-0.9**	**-38.8**	**-64.9**

Source:
Based on Saskatchewan Agriculture and Food 2007 Crop Planning Guide

Table 19: Eastern Canada (Ontario) crop budgets

	Corn - Conventional Tillage	Roundup Ready® Spring Canola	Non GMO Soybeans No Till	Roundup Ready® Soybeans No Till	Soft Winter Wheat No Till	Spring Wheat	Barley
Seed	147.5	143.5	86.2	144.9	87.7	111.0	79.5
Seed Treatment	0.0	0.0	12.3	12.3	0.0	0.0	0.0
Fertilizer	207.5	142.8	37.2	37.2	137.9	111.2	111.7
Pesticides	91.7	12.8	116.5	44.2	17.0	15.8	51.2
Total Inputs	**446.8**	**299.1**	**252.2**	**238.6**	**242.6**	**238.0**	**242.5**
Tillage	94.3	87.5	0.0	0.0	0.0	87.5	87.5
Planting	38.1	38.0	51.9	51.9	49.4	38.0	38.0
Spraying	22.5	22.5	44.9	44.9	22.5	22.5	22.5
Fertilizing	22.6	22.6	22.6	22.6	22.6	22.6	22.6
Harvesting & Trucking	156.8	93.8	105.6	105.6	115.2	98.4	109.0
Total Machinery	**334.2**	**264.4**	**224.9**	**224.9**	**209.6**	**269.0**	**279.6**
Drying	154.6	0.0	19.9	20.0	0.0	0.0	0.0
Crop Insurance	27.7	33.1	24.4	24.4	15.8	15.2	10.5
Interest @ 7.0%	32.2	16.9	16.2	15.7	23.2	14.0	18.3
Marketing & Other	73.6	8.4	23.7	23.7	9.4	4.1	0.0
Total Costs ($/ha)	1069.0	622.0	561.4	547.3	500.6	540.2	550.9
Total Costs ($/ton of output)	**141.5**	**312.4**	**226.2**	**220.5**	**110.4**	**171.8**	**171.2**
Yield (kg/ha)	7.555	1.991	2.482	2.482	4.536	3.145	3.218
Price ($/ton)	163.780	326.091	290.441	290.441	174.760	213.450	126.364
Gross Return ($/ha)	1237.3	649.2	720.8	720.8	792.8	671.4	406.7
Net Margin / Hectare	**168.3**	**27.2**	**159.5**	**173.5**	**292.2**	**131.2**	**-144.2**
Net Margin / ton of output	**22.3**	**13.7**	**64.3**	**69.9**	**64.4**	**41.7**	**-44.8**
Less: Land Cost/Rent*	223	223	223	223	223	223	223
Less: Utilities / Acct/Misc.							
Net Return /Hectare	-54.5	-195.5	-63.3	-49.2	69.4	-91.6	-367.0

Notes:
***** The crop comparison summary table is derived from the individual budgets in the publication. Some expense items have been combined in the summary table.
For the breakout of the individual expenses refer to the respective budget in the publication.
® Roundup Ready varieties are registered products of Monsanto Canada Inc.
1. There are 25.4 kg of corn in a bushel; 27.2 kg of soybeans and 27.2 kg of wheat
2. 1 acre = 0.404 hectares

1. *land rent assumed to be $90/ac but can vary greatly
2. Yield: 1995 – 2005 average
3. Price: corn, soybeans, wheat – Mar 13, 2006; canola, barley 1995 – 2005 average.

Sources:
1. Individual Crop Budgets http://www.omafra.gov.on.ca/english/busdev/facts/pub60.htm#top
1. Unit Conversions http://www.notill.org/past_conf/WC05/Metric%20Conversion%20Table.xls.
Ontario Corn Price: http://www.farms.com/readstory.cfm?dtnnewsid=1497598
Ontario Winter Wheat Price http://www.ontariowheatboard.com/Daily%20Cash%20Prices/Basis.html
Crop Yields: Statistics Canada -Estimated areas, yield, production and average farm price of principal field crops, in metric units, annual http://estat.statcan.ca/cgi-win/CNSMCGI.EXE
Land Rent in Ontario: Ontario Corn Growers Association http://www.ontariocorn.org/growing/cost.html

Table 20: Typical Rotation (Ontario) crop budget

	Not Genetically Altered Conventional Soybeans	Not Genetically Altered Conventional Corn	Conventional Hard Red Winter Wheat	Rotation Average
Expected yield (ton/ha)	2.5	7.6	4.8	4.9
Expected price ($/ton)	290.4	163.8	196.8	217.0
Total Market Revenue (Yield x Price)	720.8	1237.3	1073.2	1010.4
Total Revenue	720.8	1237.3	1073.2	1010.4
Seed	**86.2**	**147.5**	**112.7**	115.5
Fertilizer - Manure, compost**	**0.0**	**0.0**	**32.0**	10.7
Fertilizer[1] - 28 kg/ac MAP 11-52-0	**0.0**	**33.0**	**153.0**	62.0
Fertilizer - 40 kg/ac 6-24-24	**37.2**	**0.0**	**0.0**	12.4
Muriate of Potash 0-0-60	**0.0**	**29.0**	**0.0**	9.7
Fertilizer[1] - 52 kg/ac N (186 kg/ac of 28-0-0 U.A.N.)	**0.0**	**145.6**	**0.0**	48.5
Total Fertilizer	**37.2**	**207.5**	**184.9**	143.2
Herbicide - annual grass and broadleaf weeds	**94.4**	**91.7**	**17.0**	67.7
Herbicide - other weed control, if required	**12.3**	**0.0**	**0.0**	4.1
Tractor and Machine Expenses - Fuel (18 L conv., 16 L min, 12 L no till) and lubricant	**25.1**	**37.3**	**25.1**	29.1
Tractor and Machine Expenses - Repairs and maintenance	**41.6**	**41.0**	**39.1**	40.6
Marketing fees ($0.40/tonne)	**2.6**	**3.7**	**0.0**	2.1
Crop insurance	**24.4**	**27.7**	**15.8**	22.6
Marketing board fee ($2.00/tonne)	**0.0**	**0.0**	**9.4**	3.1
Custom work (fertilizer appl., mixing & delivery)	**22.6**	**22.6**	**22.6**	22.6
Custom work (pesticide application)	**22.5**	**22.5**	**22.5**	22.5
Trucking ($7.00/tonne)	**17.5**	**0.0**	**0.0**	5.8
Storage ($1.91/month/tonne x 4 months)	**21.1**	**63.8**	**29.6**	38.2
Drying (16.92/tonne, 8 points)	**19.9**	**154.6**	**0.0**	58.1
Land rent	**0.0**	**0.0**	**0.0**	
Operator labour (self or hired)	**21.0**	**29.3**	**21.0**	23.7
Storage ($1.91/tonne/month x 4 months)	**0.0**	**69.9**	**0.0**	23.3
Interest on operating	**15.7**	**32.2**	**0.0**	16.0
Interest on operating	**0.0**	**0.0**	**29.0**	9.7
Total Operating Expenses	**464.1**	**951.2**	**528.8**	648.0
Overhead Expenses	**219.4**	**209.4**	**217.0**	
Machinery - Depreciation	**68.6**	**64.8**	**67.4**	67.0
Machinery - Interest on investment	**48.4**	**42.2**	**47.2**	45.9
Land	**89.2**[1]	**89.2**	**89.2**	89.2
Other overhead	**13.2**	**13.2**	**13.2**	13.2
Total Expenses	**683.5**	**1160.7**	**745.7**	863.3
Gross Margin (Revenue - Operating Expenses)	**256.7**	**286.0**	**544.4**	362.4
Net Revenue (Revenue - Total Expenses)	**37.3**	**76.6**	**327.4**	147.1
Breakeven price (total expenses/expected yield):	**275.4**	**153.6**	**155.4**	194.8

Notes: Assuming 40% of farm land is rented at $90/ac ($223/ha)

8 Key Environmental and Health Related Issues Related to Production of Grains and Oilseed and Main Features of Legislation and Policy

8.1 Nature Conservation and Biodiversity

Lefebvre *et al* (2005) indicated that Wildlife Habitat on Farmland was used to measure the effect of agricultural practices on biodiversity. Table 21 shows that from a national perspective, there was deterioration in the capacity of farmland to provide wildlife habitat. Wildlife Habitat on Farmland was positively influenced by land management trends such as decrease in the species-impoverished summer fallow area; by land use changes such as increases in the area of forage crops, woodlots and wetlands; and by the conversion of about half a million hectares of marginal cropland on the Prairies to tame forages. However, these improvements did not completely offset the negative impact of the increase in the relative percentage of farmland used as cropland and the decline in species-rich natural pastures. Saskatchewan was the only Province that showed some improvement in the provision of wildlife habitat on farmland. This resulted from a significant decrease in summer fallow area and small increases in wetlands sand woodlands, which compensated for an expansion in cropland and a reduction in natural pastures.

8.2 Nitrates from Agriculture and Groundwater

A recent (2006) Ipsos-Reid survey showed that about half of Canadian farms have some sort of open water (i.e. river, lake, creek). For Atlantic region this figure is much higher (77%) than for the western Canada (44%). However, farms whose main enterprise is field crop production are less likely to have open water on the farm (42%) than the mainly livestock producing farms (55%). Of those farmers that apply manure, more than half have open water bodies on their farm. A third of the field crop growers in Canada apply manure in addition to chemical fertilizers. Manure usage is more common in Atlantic Canada than in the West (Crop Nutrients Council, 2006).

Table 21: Manure Application Intensity and Livestock Density in Canada by Province, 2001

			Province										
		Row Number	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	New Brunswick	Nova Scotia	Prince Edward Island	Newfoundland	Canada
Land that Received Manure	Area ('000 ha)	[1]	94	515	266	238	722	760	41	46	33	5	2,721
	Share of Total Cropland* Area (%)	[2]	15.3	5.3	1.7	5.1	19.8	41.1	27.6	38.9	18.6	64.9	7.5
	Share of Total Agricultural** Land Area (%)	[3]	3.6	2.4	1.0	3.1	13.2	22.2	10.6	11.4	12.5	13.5	4.0
Livestock Units per Area of Land That Received Manure (LU/ha)		[4]	10.3	10.9	9.2	7.2	4.3	3.3	3.7	3.8	3.1	6.2	6.2
Livestock Units per Area of Cropland (LU/ha)		[5]	1.6	0.6	0.2	0.4	0.9	1.4	1.0	1.5	0.6	4.0	0.5
Livestock Units per Area of Agricultural Land (LU/ha)		[6]	0.4	0.3	0.1	0.2	0.6	0.7	0.4	0.4	0.4	0.8	0.2
Nutrients per Hectare of Land that Received Manure*** (kg/ha/year)	Nitrogen	[7]	322	389	334	234	129	94	106	110	99	149	203
	Phosphorous	[8]	149	181	151	111	63	46	52	53	48	74	96
	Potassium	[9]	358	465	397	267	142	101	112	116	115	129	234
Nutrients per Hectare of Cropland** (kg/ha/year)	Nitrogen	[10]	49	21	6	12	25	38	29	43	19	97	15
	Phosphorous	[11]	23	10	3	6	12	19	14	20	9	48	7
	Potassium	[12]	55	25	7	14	28	41	31	45	21	84	17
Nutrients per Hectare of Agricultural Land** (kg/ha/year)	Nitrogen	[13]	12	10	3	7	17	21	11	13	12	20	8
	Phosphorous	[14]	5	4	2	3	8	10	5	6	6	10	4
	Potassium	[15]	13	11	4	8	19	22	12	13	14	17	9

Notes:

1. [4], [5] and [6] were calculated by using the worksheet for livestock unit calculations produced by the Minnesota Department of Agriculture, adjusted to Canadian Census of Agriculture classification of farm animals (See Appendix 1).
2. [7], [8] and [9] were calculated by dividing the total nitrogen, phosphorous, and potassium content of manure (produced by all cattle, pigs, sheep, horses, and poultry reported in 2001 Census over a period of one year) respectively by [1].
3. The total nitrogen, phosphorous, and potassium content of manure is calculated by using information on production and nutrient content of manure from various farm animals (see (1.) under *Sources*), adjusted to Canadian Census of Agriculture classification of farm animals (see Appendix 2).
4. *Excluding area under Christmas tree plantations
5. **Agricultural Land Area = Cropland Area + Pastures (+ any land that is used for agricultural production but not currently cropped)
6. ***Assuming zero nutrient loss during storage and application. Nutrient loss can range from 10% to 75% depending on the storage conditions, nutrient, and animal.
7. [10] through [12] were calculated by dividing the total nutrient output per year by the area of cropland.
8. [13] through [15] were calculated by dividing the total nutrient output per year by the area of farmland.

Sources:

1. Oregon State University, Total production and nutrient content of manure from various farm animals: http://extension.oregonstate.edu/catalog/html/ec/ec1094/EC109402-00.jpg
2. Minnesota department of Agriculture. Animal Unit Calculation Worksheet: http://www.mda.state.mn.us/feedlots/dmt/aucalcws.htm?SEARCH.X=0\&SEARCH.Y=0
3. Statistics Canada, Census of Agriculture, 2001, Land Use, Tenure and Management Practices: http://tdr.uoguelph.ca.cerberus.lib.uoguelph.ca/DRC/DATA/AGRIC/AGCENSUS/2001/B2020/part2.html

Table 22: Fertilizer Application Intensity in Canada by Province, 2001

			Province							
		Row Number	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	Atlantic Provinces*	Canada
Fertilized Land Area	Area ('000 ha)	[1]	347	6,700	9,909	3,531	2,232	1,002	295	24,015
	Share of Total Cropland Area (%)	[2]	56	69	64	75	61	54	65	66
	Share of Total Agricultural Land Area (%)	[3]	13	32	38	46	41	29	27	36
Nutrients Applied** per Hectare of Fertilized Land (kg/ha)	Nitrogen	[4]	73	66	54	86	76	98	94	67
	Phosphorous	[5]	27	23	22	30	34	48	81	26
	Potassium	[6]	20	8	3	10	50	56	83	13
Nutrients per Hectare of Cropland (kg/ha)	Nitrogen	[7]	41	46	35	64	47	53	61	44
	Phosphorous	[8]	15	16	14	23	21	26	53	17
	Potassium	[9]	11	5	2	7	31	30	54	9
Nutrients per Hectare of Farm Land (kg/ha)	Nitrogen	[10]	10	21	20	40	31	29	25	24
	Phosphorous	[11]	4	7	8	14	14	14	22	9
	Potassium	[12]	3	2	1	5	21	16	22	5

Notes:

1. * Data on fertilizer purchases not available for individual provinces: New Brunswick, Nova Scotia, Prince Edward Island, and Nova Scotia; only the aggregate number available
2. **Assuming all purchased fertilizer was applied
3. [4], [5], and [6] were calculated by dividing the nitrogen (N), phosphorous (P_2O_5), and Potassium (K_2O) content of the total purchased fertilizer in 2001 by [1]
4. [7], [8], and [9] were calculated by dividing the nitrogen (N), phosphorous (P_2O_5), and Potassium (K_2O) content of the total purchased fertilizer in 2001 by the area of cropland in 2001
5. [10], [11], and [12] were calculated by dividing the nitrogen (N), phosphorous (P_2O_5), and Potassium (K_2O) content of the total purchased fertilizer in 2001 by he area of farmland in 2001

Sources: Agriculture and Agri-Food Canada, Canadian Fertilizer Consumption, Shipments and Trade, 2000/2001:
http://www.agr.gc.ca/pol/pub/canfert/pdf/canfert00_01_e.pdf
Statistics Canada, Census of Agriculture, 2001, land Use, Tenure and Management Practices:
http://tdr.uoguelph.ca.cerberus.lib.uoguelph.ca/DRC/DATA/AGRIC/AGCENSUS/2001/B2020/part2.html

Table 23: Total Nutrients per Hectare of Cropland and Farm Land from Commercial Fertilizer and Manure in Canada by Province, 2001

			Province							
	Nutrient	Row Number	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	Atlantic Provinces*	Canada
Nutrients per Hectare of Cropland (kg/ha)	Nitrogen	[1]	90	66	40	76	72	91	114	59
	Phosphorous	[2]	38	26	17	28	33	45	67	25
	Potassium	[3]	66	30	9	21	59	72	86	26
Nutrients per Hectare of Farm Land (kg/ha)	Nitrogen	[4]	22	31	24	47	48	49	47	32
	Phosphorous	[5]	9	12	10	18	22	24	28	13
	Potassium	[6]	16	14	5	13	39	39	35	14

Notes:

1. * Data on fertilizer purchases not available for individual provinces
2. [1] = [10] from Table 1. + [7] from Table 2.
3. [2] = [11] from Table 1. + [8] from Table 2.
4. [3] = [12] from Table 1. + [9] from Table 2.
5. [4] = [13] from Table 1. + [10] from Table 2.
6. [5] = [14] from Table 1. + [11] from Table 2.
7. [6] = [15] from Table 1. + [12] from Table 2.

Table 24: Nutrient Output (Including Runoff and Leakage from Manure Storage) versus Crop Removal in Canada by Province 2001

		Row #	British Columbia	Alberta	Saskatchewan	Manitoba	Ontario	Quebec	Atlantic Provinces	Canada
Total Nutrients from Manure and Fertilizer (‘000 ton)	Nitrogen*	[4]	55,705	643,303	619,795	357,684	263,254	169,098	32,076	2,140,915
	Phosphorous	[5]	23,271	248,148	255,330	133,416	121,169	83,045	30,373	894,751
	Potassium	[6]	40,742	291,507	135,614	98,364	214,875	132,520	38,807	952,428
Total Nutrient Removal in the Form of Biomass (‘000 ton)	Nitrogen	[1]	25,212	376,935	471,031	218,262	177,198	108,817	25,209	1,402,664
	Phosphorous	[2]	12,674	162,000	209,932	95,926	105,981	59,351	8,880	654,743
	Potassium	[3]	40,141	200,297	182,500	128,752	188,884	122,524	27,161	890,259
Total Nutrient Balance ('000 ton)	Nitrogen	[7]	30,493	266,369	148,764	139,422	86,056	60,280	6,867	738,250
	Phosphorous	[8]	10,596	86,148	45,398	37,490	15,188	23,695	21,493	240,008
	Potassium	[9]	601	91,209	-46,885	-30,388	25,991	9,995	11,646	62,169
Nutrient Balance per Hectare of Cropland(kg/ha)	Nitrogen	[10]	49	27	10	30	24	33	15	20
	Phosphorous	[11]	17	9	3	8	4	13	48	7
	Potassium	[12]	1	9	-3	-6	7	5	26	2

Notes:

1. Additional tables that show how [1], [2], and [3] were calculated are available.
2. *About 43% of manure nitrogen is lost as ammonia during storage and application (estimation calculations available).
3. [7] = [4] - [1]
4. [8] = [5] - [2]
5. [9] = [6] - [3]
6. [10] = [7]/Cropland Area
7. [11] = [8]/Cropland Area
8. [12] = [9] /Cropland Area

Sources:

1. International Plant Nutrition Institute: Eastern Canada Nutrient Balance: http://www.ipni.net/ppiweb/canadae.nsf/$webindex/article=676E06E085256BC800762A4C98E91317
2. Census of Agriculture, 2001, land Use, Tenure and Management Practices: http://tdr.uoguelph.ca.cerberus.lib.uoguelph.ca/DRC/DATA/AGRIC/AGCENSUS/2001/B2020/part2.html
3. Agriculture and Agri-Food Canada: Canadian Fertilizer Consumption, Shipment and Trade: http://www.agr.gc.ca/pol/pub/canfert/pdf/canfert00_01_e.pdf
4. Atmospheric nitrogen Loss (as ammonia):http://www.agr.gc.ca/nlwis-snite/index_e.cfm?s1=pub&s2=ha_sa&page=87

8.3 Evidence of Nitrate Contamination

Relative number of wells with nitrate concentrations in excess of the maximum acceptable concentration for drinking water in Ontario (10 mg/l) between 1950 and 1990, as shown in Table 25 ranged from 5 to 20%, which is somewhat lower than in the U.S. Although the current nitrate concentrations in groundwater do not pose a serious ***health*** risk, they could potentially increase as the Canadian population increases and agricultural production expands or intensifies. Thus, understanding the potential reasons for excessive use of nitrogen fertilizer may help address this issue.

Table 25: Results of Ontario well water surveys between 1950 and 1992 on the percentage of wells contaminated with nitrates, coliform bacteria, and pesticides

Survey years	Number of wells surveyed	% of wells contaminated		
		Nitrate - nitrogen	Coliform bacteria	Pesticide detections[3]
		>10/100 mL	>10 colonies/100 mL	
1950-1954	484	14	15[1]	-[4]
1980	37	5	43	-
1954-1985	63	21	-	-
c. 1985	49	5	-	-
1979-1984	359	-	-	37
1981-1984	102	-	-	14
1984	91	-	-	13
1986	103	15	-	10
1987	76	7	-	5
1990	566	12	37	-
1991	301	15	34[2]	10
1991-1992	142	7	44[2]	-

Source: Goss *et al.* (1998)
Notes:
1. Data for E. coli.
2. Data for fecal coliform.
3. The threshold level of pesticide detection across surveys varies, and it is not reported by Goss *et al.* (1998)
4. No data available

8.4 Soil Quality

8.4.1 Soil Erosion and Surface Water

According to OMAFRA (undated), almost all farms in Ontario are affected by water, wind and to a lesser extent, tillage erosion. Farming practices increased rates of erosion and farmers have suffered from problems such as decreased crop yields, increased cost of production, degraded topsoil, increased runoff and reduced water storage. Off the farm, eroded soils have increased the cost of maintaining drains and shipping channels, destruction of fish habitat and recreational waters and contamination of surface waters through runoff carrying pesticide residues and soil nutrients. Past management practices that contributed to water erosion included performing fall primary tillage every year, practicing tillage up and down slope, growing row crops, leaving no crop residue on the soil surface and using fine seedbeds, which tend to be packed and rolled. [Direct quote from D9; will be modified]

8.4.2 Soil Organic matter

According to OMAFRA (undated), past management practices that contributed to droughty soils included rotations with alfalfa and not using cereals, and not leaving crop residues on the soil surface
OMAFRA (undated) states that past management practices that contributed to subsidence included draining soils and tilling regularly. [Direct quote from D9; will be modified]

8.4.3 Soil Structure

OMAFRA (undated) state that past management practices that contributed to soil crusting include seedbed worked very fine with more than 3 tillage passes; use of the disk (tends to pulverize and pack soil); no crop rotation used, or limited use of legumes or grasses; cover crop not used (soil left bare); crops that return very little crop residue to the soil are grown regularly (soybeans, edible beans, tomatoes, peas); and no residue left on soil surface after planting.
Past management problems that contributed to soil compaction include unchanged depth in primary tillage practices; tilling when soil is wet or below tillage depth; short rotations with few forages/cereals and insufficient frost penetration to 15 centimetres or more.

8.4.4 Trend in Soil Quality Indicators

However, soil quality indicators improving (D9) and thus risk of water contamination due to erosion should be declining.

8.5 Greenhouse Gasses

Lefebvre *et al* (2005) also report that the effect of agricultural activities on air quality was measured by the agricultural greenhouse gas budget. Table 21 shows that nationally, land use changes and land management practices (reduced summer fallow and increased conservation tillage) led to increases in soil carbon sequestration and which more than offset increases in nitrous oxide and methane emissions (attributable to increases in the use of nitrogen fertilizer and beef cattle population). Alberta and Manitoba were the only provinces that recorded net increases in agricultural greenhouse gas emissions. [Direct quote from D9; will be modified]

Table 26: Overview of studies examining levels of Phosphorous emissions from agricultural soils in Ontario

Tile drainage from Brookston clay crpped to corn, bluegrass, and rotational crops	Six-year average total soluble P losses with and without fertilizer P were 0.12 and 0.19 kg/ha/yr. Highest P losses occurred with fertilized, continuous corn(six-year average = 0.29 kg/ha/yr). Concentrations of total soluble P in drainage waters, with and without fertilizer P, averaged 0.18 and 0.21 mg P/L.	Bolton et al., 1970
Six-year study of effects of manure and fertilizer on P losses in tile drainage and surface runoff from a Mountain sandy clay loam (Aquic Eutrochrept) cropped to continuous silage corn	Two-year average ortho-P concentrations in tile drainage from three springtime flow events were 0.01 mg/L for check plots and plots fertilized at 134 kg/P per ha vs. 0.02 to 0.17 mg/L for manured plots. Winter applied manure resulted in the highest ortho-P concentrations in the effluent. Surface runoff concentrations of ortho-P were always higher than in tile drainage , ranging from 0.12 mg/L (check) to 1.95 mg/L (highest manure rate).	Phillips et al. 1981
Tile drainage from two eastern Ontario watersheds dominated by Brandon clay loam soils (Typic Haplaquoll)	Average annual ortho-P concentrations variad little in the 6-yr study (0.01-0.07 mg P/L in one watershed and 0.01-0.12 mg/L in the second). Canadian surface water quality limits of ortho-P at that time were 0.065 mg/L. Loses of P were less than 1% of total annual inputs of P to the watersheds.	Phillips et al., 1982
Two studies evaluating crop rotation and P fertilizer rate effects on P losses in tile drainage from Brookston clay loam soil (Haplaquoll)	Experiment 1: Sediment P concentrations in tile drainage from continuous corn were twice those from grass sod; however, total dissolved P (TDP) concentrations from bluegrass sod (0.57 mg/L) were sixfold those from corn (0.09 mg/L). Fertilization (30 kg P/ha per yr) increased concentrations of all forms of P in tile drainage (e.g. TDP in	Culley et al., 1983

	unfertilized plots was 0.05 mg/L vs. 0.15 (corn) to 1.1 mg/L (bluegrass) for fertilized plots). Experiment 2 showed that increasing tile drain depth from 0.6 to 1.0 m decreased export of sediment P (from 0.47 to 0.18 kg/ha) and tdp (from 0.36 to 0.14 kg/ha/yr).
Watershed scale-study estimating P losses in tile drainage, soil erosion, and surface runff, from agricultural cropland dominated by poorly drained Brookston clay solis	Estimates of P losses from drainage were determined from tile drainage data from experimental plots (0.1 ha) located in the watershed and prrecipitation, stream flow, runoff, and cropping information obtained from within the 51 km2 watershed. Based on these data the authors estimated that at least 25% of the total P and 50% of ortho-P export from the watershed came from drainage. Conservation strategies to reduce and soluble P losses via drainage were recommended for water quality improvement

Add more recent studies

Sources:

1. Sims et al. (1998)

9 Inventory of Environmental and Health Related Standards, Policies and Programs Related to Production of Cereals

9.1 Groundwater and Nitrogen

As previously indicated, there is not a nitrate directive, so to speak, that can be similarly applied in Canada as in the EU. The water quality guideline for nitrate-nitrogen concentration is 10 milligrams per litre (Fairchild et al, 2000). There are many regulations and guidelines that protect the environment from agricultural pollutants such as nitrates. [Direct quote from D9; will be modified]
Ontario Nutrient Management Act (2002) sets out standards for land application of agricultural source materials. Since many farms, along with cereal crops, are engaged in some sort of livestock production, they would be affected by this legislation.

9.1.1 Ontario Nutrient Management Act (2002)

Under the section *Management of Materials containing Nutrients and Regulations respecting Farm Animals,* it is stated that "The Lieutenant Governor in Council may make regulations, prohibiting the application of materials containing nutrients to lands except in accordance with a nutrient management plan prepared or approved in accordance with the regulations and permitting deviations from the plan in the circumstances specified in the regulations or where the deviation is approved by a person specified in the regulations" and regulations requiring that nutrient management strategies for municipalities and generators of prescribed materials, or for prescribed classes of those municipalities and generators, be prepared or approved by persons who meet the qualifications specified in the regulations or who are appointed by any Minister responsible for the administration of a provision of this Act for the purpose of giving the approval"
"A nutrient management plan (NMP) details how nutrients are to be applied to a given land base. A nutrient management plan is based on both the components of the nutrients used and the characteristics of the field. This plan optimizes the utilization of the nutrients by crops in the field and minimizes environmental impacts. A person who owns or controls an agricultural operation, which is phased in by the Regulation, Part 2, and generates ≥ 300 NU or is located within 100 meters of a municipal well must complete a nutrient management plan if they land apply nutrients on their farm unit. For those farms that receive non-agricultural source materials then an approved plan will also be required" (OMAFRA, 2007).

"A nutrient management strategy sets out an environmentally acceptable method for managing all prescribed materials generated at an agricultural or non-agricultural operation. All generators of prescribed materials must complete a nutrient management strategy if they are phased in by the Regulation, Part 2**"** (OMAFRA, 2007)**.**

9.2 Soil Quality

9.2.1 Environmental farm plan

The Government of Canada Canada's National Environmental Farm Planning Initiative is aimed to help Canada's agricultural producers develop and implement voluntary environmental farm plans (EFPs) through provincially delivered EFP programs. Objectives of the National Environmental Farm Plan Initiative include helping the agriculture sector better identify its impacts on the environment; and promoting the growth of stewardship activities within the agriculture industry (AAFC, 2006). After attending an EFP workshop and completing a workbook designed to assess the current state of the farm and identify areas of concern, farmers develop an action plan for addressing the areas of concern. The action plan is then confidentially reviewed by a group of locally appointed farmers. Once the Peer Review Committee approves the Action Plan, a farmer can participate in the EFP Cost-Share Program that helps cover a portion of the costs of implementing eligible projects from the action plan. (OMAFRA, 2006). As a part of its technical assistance activities for implementing an environmental farm plan, OMAFRA provides contains 23 info sheets designed to help farmers assess the current state of their farm and develop strategies for developing action plans. Infosheet #15 relates to soil management and outlines the following potential areas of concern and possible remedial measures (i.e. Best Management Practices):

Soil Erosion

15-1 Potential for water erosion
15-2 Potential for wind erosion
15-3 Evidence of sheet erosion
15-4 Evidence of rill or gully erosion
15-5 Land highly erodible by water
15-6 Land highly erodible by wind
15-7 Marginal lands

Management
15-8 Potential for soil compaction
15-9 Field Traffic
15-10 Soil structure
15-11 Water Infiltration
15-12 Soil drainage (profile)
15-13 Amount of organic matter in the soil as measured by soil test
15-14 Soil movement from tillage
15-15 Amount of tillage
15-16 Tillage depth

9.2.2 Buffer Strips

According to OMAFRA (2004b), the overall stability of a watercourse is the land use activity that takes place immediately adjacent to it. Experience shows that if a few feet of permanent

grass cover can be maintained in this critical area, the stability of the watercourse is increased considerably. A permanently vegetated strip along an open watercourse also acts as a filter for sediment and nutrient runoff from adjacent farmland. This grassed area, normally 10-15 ft (3-5 m) wide, is called a buffer strip. Land use activity that destroys the grass cover - such as ploughing, cultivating and planting row or cereal crops – should not be done in this area. It is also important to control weeds in the buffer strip.

9.2.3 Erosion Control Structures

According to Ontario's Best Management Practices for Soil Management (OMAFRA, undated), erosion control structures help to control surface runoff to reduce soil erosion. These structures include terraces, grass waterways, water and sediment control basins, stabilization of streambanks and livestock and machinery crossings. We discuss some of these structures.

Terraces: According to OMAFRA (2004d), terraces reduce erosion by controlling and managing surface run-off. A terrace is a channel with a supporting downslope ridge constructed across the slope. Terraces break up long slopes into a series of short ones with each one collecting excess water from an area above it. The collected water is then removed from the field safely. Terraces allow for more intensive row cropping while keeping erosion in check. Steepness of slope, soil erodibility, crop type, management and rainfall, all determine terrace spacing. Recommended terrace spacing with and without a management conservation system is shown in . Adjustments should be allowed for matching equipment dimensions and fitting the topography better. Where more than one terrace is planned, care should be taken to ensure the ridges are parallel. Suitable outlets for the collected water behind the terrace include either vertical pipe intakes outletting into tile drains, or grass waterways. Conservation tillage and contouring are necessary to maintain terrace systems. There are three choices to terrace design: broad base, grass backslope and narrow base. With respect to broad base, the entire terrace is farmed. It is restricted to field slopes under 8%. Care must be taken not to work down the ridges during field operations. Grass backslope is better suited to steeper land. The backslope should be seeded to permanent vegetation. If both front and back slopes are steep then the design should be narrow base and seeded to permanent vegetation.

Table 27: Recommended Terrace Spacing With and Without a Management Conservation System

Field Slope (%)	Without Conservation Management System (metres)	With Conservation Management System (metres)
0-1	90	120
2-3	75	110
4-5	55	90
6-8	45	75
9-12	35	60

Source: OMAFRA (2004d). "Field Crop Production"

Grass waterways: According to OMAFRA (2004d), grass waterways are broad, shallow channels, which protect against erosion by grass cover. They serve as outlets for terraces, diversions, and contour rows or as passageways for surface flows entering the farm from other land. Water will often collect along natural depressions in the field and run off. Grass waterways must be wide and deep enough to handle all rains without damage. They must also be shaped to allow easy crossings by farm machinery. Crop rows should always enter the waterway at right angles. The waterway must be well drained to encourage vigorous grass growth and to protect the waterway from rutting when farm machinery crosses it. Tile drains can be installed along one, or both sides. A surface inlet may be installed at the upper end of the waterway to intercept long-running, overland water flow. Occasionally, grade control is required to maintain the waterway through steep slopes. Irregular-shaped rock over a filter cloth is a most commonly used material.

Stabilization of Streambanks: According to OMAFRA (2004d), stabilization of streambanks begins on land near to streams. Cropland should be separated from the watercourse with permanent buffer strips at least 3 metres in width.

Livestock Fencing and Stream Crossings: According to OMAFRA (2004b), livestock, if allowed access to watercourses, have a detrimental effect on the stream water quality. They destroy the grass cover on the ditch bank, leaving the bank susceptible to erosion. Soil is physically "tramped" down the bank into the stream bottom, interfering with proper operation of the drain. This increases sediment load to the drain. Water quality is also adversely affected by the increased bacterial load due to defecation from livestock being in the watercourse. Restricting livestock access to waterways will improve water quality for all users. Where livestock must receive their water supply from the stream, a pumping system should be installed to move water from the stream to an environmentally safe area away from the water source. Nose pumps and solar pumps may be used where hydropower is not available. Often livestock have to cross the waterway to get to a pasture area on the other side of the stream. When this occurs, a low flow, mid-level stream crossing with culverts, together with a fencing system should be installed to provide a restricted location for crossing. Various types of fencing systems are available for use along watercourses. The page wire fencing system is a standard farm fencing system of a permanent form. A variety of fence heights, wire sizes and wire spacing could be used. The barbed wire fencing system is permanent. For the larger livestock types, 4 strands of barbed wire are placed on posts spaced at approximately 15 ft (5 m) apart. High-tensile smooth wire fencing may be installed as either an electrified or non-electrified type. As an electric fence, this high-tensile fencing is usually considered permanent. One or 2 strands of wire are strung between posts located at approximately 50-foot (15-m) centres. The non-electrified high-tensile fence consists of 6-8 strands of wire with posts approximately 30 feet (10 m) apart and with stays at midpoints between the posts. Electric fencing, when installed as a temporary system, may be used to restrict livestock from watercourses when the pasture management program is operated on a rotational basis.

Fragile or Marginal Land Retirement: OMAFRA (2004b) point out that farmland is best used within its capability. In many instances, land is not suitable for intense agricultural production and should be classified as marginal or fragile land, which should then be retired to pasture, grasslands or woods. Marginal lands include relatively level land, which is not subject to severe erosion but due to poor drainage or shallow soils, is not suitable for cultivation. Fragile lands could include lands alongside creeks, lakes and wetlands that may

be subject to severe erosion or flooding. Fragile areas may also include land, which is too steep for regular cultivation such as slopes in excess of 15%.

9.2.4 Residue Management

OMAFRA (2004c) states that crop residues play an important part in protecting the soil from erosion and returning organic matter to the soil. Residue management is a key part of the cropping system and producers must make decisions about how best to handle crop residues in order to enhance the long-term health of the soil. Generally, it is recommended that after a crop is planted there should be no less than 30% residue on the soil surface. Most moldboard tillage followed by secondary tillage will not meet this target. Many other systems can achieve this on corn and cereal stubble. With soybean stubble, any tillage operation greater than a cultivator will achieve this target. Soil type also plays a role in how residue is managed. Soils with higher clay and silt contents often show a yield benefit to the removal of cereal straw. Another option for fields where cereals are grown is the use of a small amount of tillage to partially incorporate straw while still leaving the soil surface largely protected.

9.2.5 Crop Rotations

According to OMAFRA (2002a), the basic rule of crop rotation is that a crop should never follow itself. The greatest benefit from crop rotation comes when crops grown in sequence are in totally different families. The two families are grasses (monocots) and broad-leaves (dicots). The grasses include forage grasses, cereals and corn. Soybeans, white beans, alfalfa and canola are examples of broadleaf crops.

Table 28 shows various crop rotations that are recommended, cautioned against or not recommended depending on their impact on the crop production system.

Table 28: Various Crop Rotations

Crop to be Grown	**Previous Crop**						
	Corn	**Soybeans**	**Forages**	**Spring Cereals**	**Winter Wheat**	**Edible Beans**	**Canola**
Corn	NR	R	R	C	C	R	C
Soybeans	R	C	C	R	R	C	NR
Forages	R	R	NR	R	R	R	R
Spring Cereals	R	R	R	C	C	R	R
Winter Wheat	NR	R	R	NR	NR	R	C
Edible Beans	R	C	R	R	R	NR	NR
Canola	C	NR	R	R	R	C	NR

Notes:

1. R = Recommended; NR = Not Recommended; C = Caution
2. These recommendations are based on their impact on the crop production system. See source for details.

Source: OMAFRA (2002a). Soil Management and Fertilizer Use: Crop Rotations

9.2.6 Strip Cropping

According to OMAFRA (2004d), strip cropping is the practice of alternating strip widths of row crops with forages or cereals crops. This practice combines the soil and moisture savings of contouring with the soil building advantages of a crop rotation. There are four kinds of strip cropping: contour, field, contour buffer and wind strip cropping. The system that is chosen depends on the crops that can be grown, the kind of erosion (wind or water), the topography and the soil type.

***Contour Strip Cropping*:** Crops are arranged in bands at right angles to the natural slope of the land. In nature, slopes are seldom perfectly uniform. Therefore, a compromise is made in the contour layout. While it is difficult to imagine, if both strip edges are on the contour, all strips will be irregular in width. Alternating irregular-width strips with one or more even-width strips is recommended.

***Field Strip Cropping*:** Strip cropping maintains strips of uniform width across a slope. As with contour strip cropping, this system can reduce erosion by up to 75% when compared to up-and-down hill farming. In laying out this type of system, recommended strip widths, as shown in Table 29 should be adjusted to blend with equipment widths, especially planters and sprayers. An even number of passes along each strip will allow field operations to start and finish at the same end of the field. Grass field borders are an integral part of any strip cropping system and are described below in "Contouring and grass field borders."

Table 29: Maximum Strip Widths and Slope Length Limits for Contour and Field Strip Cropping

Land Slope (%)	Strip Width (metres)	Maximum Slope Length (metres)
1-2	40	240
3-5	30	180
6-8	30	120
9-12	25	75

Source: OMAFRA (2004d). "Field Crop Production"

***Contour Buffer Strip Cropping*:** Contour buffer strips are permanent strips of grass or forage laid out between even-width strips of crops in regular rotation. Grass strips as narrow as four metres (13 feet), making up as little as 10% of the entire field, may reduce erosion rates by up to 55% while doubling the slope length limits for contouring. Buffer strip locations are based on crop rotation and the severity of slope. On irregular slopes, grass strips will be of different widths to make annually cropped strips even. Table 30 shows the maximum slope lengths for contour buffer strip cropping.

Table 30: Maximum Slope Length Limits for Contour Buffer Strip Cropping

Land Slope (%)	Maximum Slope Length (metres)
1-2	240
3-5	180
6-8	120
9-12	75

Source: OMAFRA (2004d). "Field Crop Production"

***Wind Strip Cropping*:** For soils on level land, alternate strips should be even in width, parallel and laid out crosswise to the prevailing winds. Recommended widths for wind strip cropping are shown in Table 31.

Table 31: Recommended Widths for Wind Strip Cropping

Soil Texture	Strip Width (metres)
Fine Sand, Fine Sandy Loam, Clay	25
Loam, silty Loam	80
Clay Loam, Silty Clay Loam	100

Source: OMAFRA (2004d). "Field Crop Production"

Contouring and Grass Field Borders: On short, gentle slopes, contour farming provides good protection against erosion. Tilling and planting across the natural slope create a series of dams, which hold back water until it can soak into the ground. Generally, contour farming on fields as steep as a 9% slope will cut erosion rates in half. Because of slope irregularities, it may not always be possible to stay on the level. When laying out the contour system, it is best to smooth curves at ridge tops and drainage ways and square the rows with field edges to eliminate 'point-rows'. These adjustments should maintain a 0.5 to 1% grade along rows. A grass waterway or tile outlet terrace must then be considered to carry surface water down the slope. Slope length limits, as shown inTable 32, should be considered in contour farming.

Table 32: Slope Length Limits for Contouring

	Maximum Slope Length	
Land Slope (%)	**(Metres)**	**(Feet)**
1-2	120	400
3-5	90	300
6-8	60	200

Source: OMAFRA (2004d). "Field Crop Production"

9.2.7 Windbreaks

According to OMAFRA (2002b), additional protection from the wind is necessary when there is not enough residue to hold soil in place. Windbreaks and shelterbelts can provide that protection by slowing down wind speeds near the ground. Windbreaks usually have five or fewer rows and shelterbelts have six or more rows.

Various experts (Rubec and Turner 2003; Hinterland Who's Who, 2006; Environment Canada, 2006; Environment Canada, 2003a; Environment Canada, Canadian Wildlife Service, 2005) report that, in 1916, Canada and the United States signed the Migratory Birds Convention, which obliged both countries to preserve migratory birds and protect them from indiscriminate slaughter. Canada implemented the convention through the *Migratory Birds Convention Act*, 1916. The *Migratory Birds Convention Act*, 1916 and the Migratory Bird Sanctuaries (MBSs) established under that Act protect migratory birds against physical disturbance and hunting but they did not protect habitat or species of wildlife other than

migratory birds. The *Canada Wildlife Act*, 1973 was passed to authorize the establishment of sites known as National Wildlife Areas (NWAs) in which migratory birds and other wildlife, particularly species at risk and more importantly, their habitat, could receive protection. In 1985, this act was revised and in 1994, there were amendments to include the creation of Marine Wildlife Areas (MWAs) (The *Canada Wildlife Act*, R.S. 1985).

Also the Migratory Birds Convention Act was amended in 1994 (*Migratory Birds Convention Act*, 1994, c. 22). AAFC (2002a) states that the Act establishes a regime for the protection of migratory birds, whose harvest occurs on agricultural lands. The *Migratory Birds Regulations* stipulates the conditions for the conservation and protection of migratory birds. These regulations control, for example, hunting and possession of migratory game birds; sale, purchase, or shipment of migratory birds, their nests or eggs; scientific collection, aviculture, and taxidermy; activities designed to reduce the damage migratory birds cause to crops or other property and the danger they pose to aircraft; and requirements for hunters to use non-toxic shot for most migratory game bird species.

Environment Canada's Canadian Wildlife Service administers a network of protected areas, which protects an estimated 11.8 million hectares of wildlife habitat. The components of the network are National Wildlife Areas (NWAs), Migratory Bird Sanctuaries (MBSs) and Marine Wildlife Areas (MWAs). There are 51 NWAs and 92 MBSs as shown in Figures 2.2A and 2.2B. Some of these NWAs and MBSs extend beyond land, incorporating freshwater and marine areas, thereby helping to safeguard 1.5 million hectares of Canada's aquatic habitat Migratory Bird Sanctuaries cover approximately 11.2 million hectares. The *Migratory Birds Sanctuary Regulations* prohibit disturbance of migratory birds, their eggs, and their nests within an MBS. The regulations also prohibit disturbance of migratory birds' habitat when MBSs are established on federal Crown land.

Environment Canada (2003a) states that the Government of Canada has developed a recovery strategy for species at risk and to prevent other species from becoming at risk. The strategy includes three elements: The *Species at Risk Act*, 2002, which came into force in June 2003, protects wildlife found on federal lands as well as their critical habitat; the accord for the Protection of Species at Risk, which allows the Government of Canada to work collaboratively with the provinces and territories in the development of a joint species at risk protection approach in Canada, including laws and complementary programs for the protection of habitats and the recovery of species; and the Habitat Stewardship Program, which encourages Canadians to join their efforts under a landscape level approach in order to protect habitats, *inter alia*.

The purposes of the S*pecies at Risk Act*, 2002 (SARA) are to prevent Canadian indigenous species, subspecies and distinct populations of wildlife from becoming extirpated or extinct, to provide for the recovery of endangered or threatened species, and to encourage the management of other species to prevent them from becoming at risk. The Act also expands the scope for applying NWAs and MWAs status to protect wildlife habitat.

A number of other laws and agreements are also in force to help in the effort to protect and recover species at risk. These include the *Fisheries Act*, R.S 1985, the *Migratory Birds Convention Act*, 1994, the *Canada National Parks Act*, 2000, the *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act*, 1992, the *Canada*

Wildlife Act, R.S 1985 and the Convention on International Trade in Endangered Species. The *SARA* also complements the work done by provincial and territorial governments under the Accord for the Protection of Species at Risk. This recognizes that species protection is a shared responsibility.
Offences are punishable under both the Migratory *Birds Convention Act,* 1994 and the

Species at Risk Act, 2002. Under the former, every person or vessel that commits an offence is liable as follows:

a. On conviction on indictment, to a fine of not more than $1,000,000 or to imprisonment for a term of not more than three years, or to both.
b. On summary conviction, to a fine of not more than $300,000 or to imprisonment for a term of not more than six months, or to both.

In the case of a vessel of 5,000 tonnes deadweight or over, an offence under section 5.1, paragraph (1.1)(a) the fine shall not be less than $500,000 and under paragraph (1.1)(b) the fine shall not be less than $100,000.
Under the *Species at Risk Act,* a person who is guilty of an offence punishable under summary conviction is liable as follows:

a. In the case of a corporation, other than in a non-profit corporation, to a fine of not more than $300, 000.
b. In the case of a non-profit corporation, to a fine of not more than $50, 000.
c. In the case of any other person, to a fine of not more than $50,000 or to imprisonment for a term of not more than one year, or to both.

In the case of an indictable offence, liability is as follows:

a. In the case of a corporation, other than a non-profit corporation, to a fine of not more than $1,000,000.
b. In the case of a non-profit corporation, to a fine of not more than $250,000.
c. In the case of any other person, to a fine of not more than $250,000 or to imprisonment for a term of not more than five years, or to both.

We conclude by noting that one measure of compliance with regulations governing the protection of birds and habitat is reported fines under the relevant legislation. We have not yet been able to gather any information concerning the degree of non-compliance by farmers under the various laws.

9.3 Adoption Level of Best Management Practices

The Tables following below summarize information available in the literature on the adoption of best management practices. The Tables distinguish between various management practices. Table 33 provides a general overview of factors detected to influence adoption. The subsequent Tables provide further details.

Table 33: Summary of Factors Affecting the Adoption of BMP's in Canada

Study	Factors Positively affecting Adoption	Factors Negatitively affecting Adoption	No Influence on adoption
Serman and Filson (1999) Soil amd Water Conservation	number of crops cultivated; farm size; gross sales; education of the producer		Producer's age; experience of producer
Agnew and Filson (2004) Healthy Futures Program	Higher income; larger farms; livestock and forage producers		education; age; previous participation in environmental programs
Agnew and Filson (2004) Environmental Farm Plans	larger livestock farms exhibit greater adoption of EFP	Participation in BMP's negatively influenced by larger revenues and producers perception of government regulation	
Agnew and Filson (2004) Watershed participants	legislation; funding of BMP's; BMP's are the "right" thing to do		
Lamba et al. (2005) Voluntary environmental programs		programs for BMP's too complex; insufficient compensation; negative effect on yields; external influences	

Source: Brethour et al., 2007

Table 34: Use of Best management Practices in Canada

Management Pracice	**% of producers using the practice**
Soil testing	75
Conservation tillage	73
No Till	53
Nutrient Management Plan	46
Buffer Strips	36
Variable Rate Fertilization	10

Source: Ipsos Reid Survey as cited by George Morris Centre (2007)

Table 35: Adoption levels of selected beneficial management practices in Canada

Best Management Practice		% of farmers using
Manure Management	Fully or partially implemented	29
	Unfamiliar with practice	39
Fertilizer Management	Fully or partially implemented	36
	Unfamiliar with practice	44
Water Management	Fully or partially implemented	31
	Unfamiliar with practice	44
Soil Testing on which to base fertilizer decisions	Fully or partially implemented	70
	Unfamiliar with practice	25
Fertilizing Methods	Broadcasting	48
	Banded	25
	Injected	12
Protection of natural water sources adjecent to agricultural land	Perrenial Vegetation	44
	Planted Vegetation	6
	Winter Cover Crops	1
Environmental Plan	Nutrient Management Plan	15
	Manure Management Plan	18
	Environmental Farm Plan	13

Source: Statistics Canada, FEMS, 2001, as cited by Brethour et al., 2007

Table 36: Method of deciding amount and type of commercial fertilizer application, by share (percentage) of methods used, Canada and provinces, 2001

	Soil testing	Foliage testing	Cost of fertilizer and crop prices	Moisture conditions	Other	Total responses[1]
Newfoundland and Labrador	43.9	X	X	X	43.9	100
Prince Edward Island	55.8	X	15.8	X	14.3	100
Nova Scotia	39.9	X	X	14.5	26.4	100
New Brunswick	54.7	8	X	X	27.5	100
Quebec	74.4	5.4	7.4	2.6	10.3	100
Ontario	61.5	3.4	13.3	4.3	17.4	100
Manitoba	48	1.5	25.8	12.1	12.6	100
Saskatchewan	31.8	1.3	31	28.4	7.5	100
Alberta	43.9	2.1	23.7	19.8	10.5	100
British Columbia	44.5	8.2	12.7	8	26.5	100
Canada	**48**	**2.8**	**21.3**	**15.8**	**12.2**	**100**

Notes: Due to rounding, figures may not add up to totals.
1. An individual farm could report more than one method. Therefore, the total in this table does not refer to the total number of farms reporting.
Data source: Statistics Canada, 2001, Farm Environmental Management Survey.
Table source: Statistics Canada, 2004, Farm Environmental Management in Canada, "Fertilizer and Pesticide Management in Canada," Catalogue number 21-021-MWE.

Table 37: Frequency of soil nutrient testing, by share (percentage) of farms, Canada and provinces, 2001

	Every year	Every 2 to 3 years	Every 4 to 5 years	Every 5 years or more	Not tested	Total
Newfoundland and Labrador	22.9	27.1	14.6	X	X	100
Prince Edward Island	29	29.8	14.9	X	X	100
Nova Scotia	10.5	22.9	17	20.6	29.6	100
New Brunswick	22.7	22.1	16.4	20.8	18.6	100
Quebec	20.1	39.2	23.3	9.1	8.3	100
Ontario	13.5	38.3	15.4	12.6	20.1	100
Manitoba	25.7	26.6	9.1	13.4	25.1	100
Saskatchewan	17.4	24.2	10.2	13.4	34.7	100
Alberta	26.4	22.5	9.3	12	29.8	100
British Columbia	15.9	22.8	10.2	18.6	32.6	100
Canada	**19.5**	**29.5**	**13.1**	**12.7**	**25.3**	**100**

Note: Due to rounding, figures may not add up to totals.
Data source: Statistics Canada, 2001, Farm Environmental Management Survey.
Table source: Statistics Canada, 2004, Farm Environmental Management in Canada, "Fertilizer and Pesticide Management in Canada," Catalogue number 21-021-MWE.

Table 38: Use of no-till across Canada and by province, 1991, 1996, 2001 and 2006 (%)

	1991		1996		2001	
	Farms	Area	Farms	Area	Farms	Area
Newfoundland	9	8	5	4	21	12
Prince Edward Island	5	1	3	2	3	2
Nova Scotia	7	4	5	3	9	8
New Brunswick	5	2	6	2	8	3
Quebec	5	3	9	4	9	5
Ontario	8	4	19	18	29	27
Manitoba	9	5	21	9	13	13
Saskatchewan	13	10	21	22	30	39
Alberta	4	3	9	10	19	27
British Columbia	9	5	8	10	13	14
Canada	**8**	**7**	**15**	**16**	**22**	**30**

Sources:

1. Brethour et al. (2007)
2. Statistics Canada ( )

Table 39: Use of conventional tillage across Canada and by province, 1991, 1996, 2001 and 2006 (%)

	1991		1996		2001	
	Farms	Area	Farms	Area	Farms	Area
Newfoundland	89	84	87	88	81	75
Prince Edward Island	94	91	88	82	90	76
Nova Scotia	91	88	89	77	88	71
New Brunswick	93	85	89	80	88	82
Quebec	94	85	89	80	89	77
Ontario	89	78	82	60	78	52
Manitoba	77	66	74	63	69	55
Saskatchewan	74	64	63	45	55	32
Alberta	83	73	74	57	63	37
British Columbia	87	84	85	66	81	65
Canada	**83**	**69**	**75**	**53**	**70**	**41**

Sources: Brethour et al. (2007), Statistics Canada

Table 40: Use of minimum tillage across Canada and by province, 1991, 1996, 2001 and 2006 (%)

	1991		1996		2001	
	Farms	Area	Farms	Area	Farms	Area
Newfoundland	10	8	16	8	18	13
Prince Edward Island	10	8	20	16	22	22
Nova Scotia	11	8	16	21	15	20
New Brunswick	12	13	18	18	16	15
Quebec	13	12	16	16	22	19
Ontario	19	18	26	22	25	22
Manitoba	29	29	31	28	31	33
Saskatchewan	28	26	39	33	33	29
Alberta	21	24	30	33	31	36
British Columbia	11	12	16	24	13	21
Canada	**22**	**24**	**29**	**31**	**29**	**30**

Sources: Brethour et al. (2007), Statistics Canada

Table 41: Commercial fertilizer application, by share (percentage) of methods used, Canada and provinces, 2001

	Broadcasting	Banded	Applied with seed	Post-plant top-side-dressing or	Injected knifed-in or	Other	Total responses[1]
Newfoundland and Labrador	55.8	16.3	X	X	X	X	100
Prince Edward Island	41	22	31.3	3.9	X	X	100
Nova Scotia	65	10.1	11.8	6.9	1.7	4.9	100
New Brunswick	50.5	14.8	X	X	X	X	100
Quebec	45.2	15.3	27.4	4.8	6.1	1.2	100
Ontario	48.8	14.6	22	4.4	7	3.1	100
Manitoba	26.3	19.6	39.9	1.6	11.3	1.3	100
Saskatchewan	8.8	20.6	57.7	1	10.7	1.1	100
Alberta	27.5	18.3	41.4	1	10.2	1.6	100
British Columbia	56.3	10.7	9.3	6.7	4.7	12.4	100
Canada	**33.4**	**17.1**	**35.9**	**2.9**	**8.5**	**2.2**	**100**

Notes:

1. Due to rounding, figures may not add up to totals.
2. The following standard symbols are used in Statistics Canada products:
   - . not available for any reference period
   - .. not available for a specific reference period
   - ... not applicable
   - p preliminary
   - r revised
   - x suppressed to meet the confidentiality requirements of the Statistics Act
   - A, B, C, D specific levels of data quality*
   - E use with caution
   - F too unreliable to be published
   - 0 true zero or a value rounded to zero
   - 0s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded

   * When the figure is not accompanied by a data quality symbol, it means that the quality of the data was assessed to be "acceptable or better" according to the policies and standards of Statistics Canada.

Source: Statistics Canada, 2001, Farm Environmental Management Survey. Available from: http://www.statcan.ca/english/research/21-021-MIE/2004002/tables.htm

Table 42: Reduction of commercial fertilizer application to offset nutrient content of manure, Canada and provinces, 2001

	Yes		No		Not applicable		Total	
	Number of farms	Share of farms (percentage)	Number of farms	Share of farms (percentage)	Number of farms	Share of farms (percentage)	Number of farms	Share of farms (percentage)
Newfoundland and Labrador	100[D]	58.8	X	X	X	X	170	100
Prince Edward Island	760[B]	72	X	X	X	X	1,055	100
Nova Scotia	805[B]	55.7	185[B]	12.8	455[B]	31.5	1,445	100
New Brunswick	595[C]	54.8	240[B]	22.1	255[B]	23.5	1,085	100
Quebec	11,970[A]	72.3	785[A]	4.7	3,785[A]	22.9	16,545	100
Ontario	18,380[A]	54.5	2,720[A]	8.1	12,605[A]	37.4	33,700	100
Manitoba	3,985[A]	36.9	1,575[A]	14.6	5,240[A]	48.5	10,795	100
Saskatchewan	6,830[A]	21.3	5,550[A]	17.3	19,625[A]	61.3	32,010	100
Alberta	9,985[A]	38.7	3,970[A]	15.4	11,870[A]	46	25,825	100
British Columbia	1,510[A]	31.9	750[A]	15.8	2,480[A]	52.3	4,740	100
Canada	**54,925[A]**	**43.1**	**15,915[A]**	**12.5**	**56,535[A]**	**44.4**	**127,390**	**100**

Notes:

1. Due to rounding, figures may not add up to totals.

Source: Statistics Canada, 2001, Farm Environmental Management Survey. Available from: http://www.statcan.ca/english/research/21-021-MIE/2004002/tables.htm

Table 43: Testing nutrient content of manure before application, Canada and provinces, 2001

	Yes for liquid manure		Yes for solid or semi-solid manure		Manure not tested		No manure applied		Total[1]	
	Number of responses	Share of responses (percentage)	Number of responses	Share of responses (percentage)	Number of responses	Share of responses (percentage)	Number of responses	Share of responses (percentage)	Number of responses	Share of responses (percentage)
Newfoundland and Labrador	X	X	X	X	125[C]	52.1	90[C]	37.5	240	100
Prince Edward Island	X	X	X	X	970[B]	78.2	230[A]	18.5	1,240	100
Nova Scotia	45[A]	2.3	45[A]	2.3	1,105[B]	56.5	750[B]	38.4	1,955	100
New Brunswick	75[A]	4.7	50[A]	3.1	855[B]	53.4	615[B]	38.4	1,600	100
Quebec	3,835[A]	15.6	4,250[A]	17.3	11,860[A]	48.3	4,585[A]	18.7	24,535	100
Ontario	2,405[A]	5.7	1,805[A]	4.3	22,950[A]	54.9	14,680[A]	35.1	41,840	100
Manitoba	480[A]	3.4	335[A]	2.4	7,465[A]	53.2	5,755[A]	41	14,040	100
Saskatchewan	205[A]	0.5	130[A]	0.3	16,830[A]	39.5	25,510[A]	59.8	42,660	100
Alberta	285[A]	0.8	585[A]	1.6	20,820[A]	55.8	15,600[A]	41.8	37,295	100
British Columbia	110[A]	1.4	240[A]	3.1	3,425[A]	44.5	3,925[A]	51	7700	100
Canada	**7,475[A]**	**4.3**	**7,490[A]**	**4.3**	**86,405[A]**	**49.9**	**71,730[A]**	**41.4**	**173,095**	**100**

Notes:

1. Due to rounding, figures may not add up to totals.
2. See standard symbols used in Statistics Canada products

Source: Statistics Canada, 2001, Farm Environmental Management Survey. Available from: http://www.statcan.ca/english/research/21-021-MIE/2004002/tables.htm

Table 44: Full or partial implementation of nutrient management plan, Canada and provinces, 2001

	Yes		No		Don't know		Total	
	Number of farms	Share of farms (percentage)	Number of farms	Share of farms (percentage)	Number of farms	Share of farms (percentage)	Number of farms	Share of farms (percentage)
Newfoundland and Labrador	F	F	X	X	0	0	X	X
Prince Edward Island	F	F	X	X	0	0	125	100
Nova Scotia	F	F	X	X	0	0	X	X
New Brunswick	X	X	X	X	0	0	270	100
Quebec	11,370[B]	95.5	480[A]	4.1	55[A]	0.5	11,905	100
Ontario	5,245[B]	90	410[A]	7	175[A]	3	5,830	100
Manitoba	1,985[C]	90.8	165[A]	7.5	35[A]	1.6	2,185	100
Saskatchewan	3,520[C]	83.9	600[A]	14.3	80[A]	1.9	4,200	100
Alberta	4,125[C]	91.9	285[A]	6.3	75[A]	1.7	4,485	100
British Columbia	975[D]	87.7	110[B]	10.1	25[A]	2.2	1,110	100
Canada[1]	**27,725[A]**	**91.7**	**2,075[A]**	**6.9**	**445[A]**	**1.5**	**30,245**	**100**

Notes:

1. Due to rounding, figures may not add up to totals.
2. See standard symbols used in Statistics Canada products

Source: Statistics Canada, 2001, Farm Environmental Management Survey. Available from: http://www.statcan.ca/english/research/21-021-MIE/2004002/tables.htm

Table 45: Reason for nutrient management plan, Canada and provinces, 2001

	Government regulations		Part of manure management plan		Concerns for the environment		Total[1]	
	Number of responses	Share of responses (percentage)	Number of responses	Share of responses (percentage)	Number of responses	Share of responses (percentage)	Number of responses	Share of responses (percentage)
Newfoundland and Labrador	0	0	F	F	F	F	X	X
Prince Edward Island	X	X	X	X	85[E]	68	125	100
Nova Scotia	X	X	F	F	X	X	X	X
New Brunswick	40[C]	13.1	130[D]	44.1	125[D]	42.4	295	100
Quebec	5,620[A]	32.6	6,100[A]	35.4	5,515[A]	32	17,235	100
Ontario	820[A]	14.4	1,895[B]	33.2	2,985[B]	52.4	5,700	100
Manitoba	200[B]	11	515[B]	28.3	1,095[C]	60.6	1,810	100
Saskatchewan	75[A]	4.1	535[B]	28.2	1,285[C]	67.8	1,895	100
Alberta	175[A]	4.4	1,500[B]	37.6	2,315[B]	58.1	3,990	100
British Columbia	105[B]	12.6	235[C]	29.1	475[C]	58.3	815	100
Canada	**7,035[A]**	**22**	**11,000[A]**	**34.4**	**13,935[A]**	**43.6**	**31,970**	**100**

Notes:

1. Due to rounding, figures may not add up to totals.
2. See standard symbols used in Statistics Canada products

Source: Statistics Canada, 2001, Farm Environmental Management Survey. Available from: http://www.statcan.ca/english/research/21-021-MIE/2004002/tables.htm
Udith K. Jayasinghe-Mudalige and Alfons Weersink (2004) (http://www.slageconr.net/sjae/sjae61f/sjae06102.pdf)

Table 46: Definition of environmental management practices

Type of BMP	Definition
WFEP	An overall assessment of environmental issues or concerns related to the farm
MMP	Explains the types of liquid, solid/semi-solid manure storage systems used (e.g. unlined lagoon, open tank, Sealed, covered tank etc.), frequency of storage and use of manure; specific treatments used (e.g. aeration, additives, separation, drying etc.), and odor control systems etc.
FMP	Explains the measures used to apply fertilizer (e.g. broadcasting, banded, post-plant top/side dressing etc.); mix of legume and chemical fertilizer to be used in each season, and their frequencies etc.
PMP	Explains certain information with respect to different application strategies of herbicide, insecticide, and fungicide; sprayer calibration techniques, and alternative methods other than chemical pesticides to control weeds, insects ad diseases etc.
WMP	Explains the sources and total volume of water to be used on a per acre basis; methods used to irrigate the land (e.g. sprinkler, drip, surface flooding etc), and ways and means of domestic water testing etc.
WCP	Explains any measures taken to conserve natural land and wildlife habitants that are adjacent to the agricultural operation (e.g. livestock fencing, cultivation of perennial forage, trees, bushes etc).
GMP	Explains any measures taken to conserve natural wetlands including rotational grazing for livestock and practices such as “carry-over” and “re-seeding”.
NMP	Explains the methods of testing nutrient content of the farm’s liquid or solid/semi-solid manure before applying it to the land; consideration of nutrient carry-overs; distance to water ways, and timing of applications etc.

Source: Jayasinghe-Mudalige and Weersink (2004)

Table 47: Rates of adoption of different EMS by crop, livestock, and mixed farms

	Livestock		Crop		Mixed		Total	
	N = 2,250		N = 5,425		N = 8,378		N = 16,053	
Type of Plan	No	%	No	%	No	%	No	%
WFEP	150	6.7	564	10.4	1304	15.6	2018	12.6
MMP	309	13.7	255	4.7	2187	26.1	2751	17.1
NMP	7	0.3	804	14.8	1263	15.1	2074	12.9
FMP	66	2.9	1493	27.5	2163	25.8	3722	23.2
PMP	55	2.4	1478	27.2	1762	21	3295	20.5
WMP	261	11.6	988	18.2	1838	21.9	3087	19.2
WCP	215	9.6	653	12	1365	16.3	2233	13.9
GMP	320	14.2	155	2.9	2081	24.8	2556	15.9

Source: Jayasinghe-Mudalige and Weersink (2004)

Table 48: Number of EMS adopted by individual farms

	Livestock		Crop		Mixed	
	N = 2,250		N = 5,425		N = 8,378	
No of EMP's adopted	No	%	No	%	No	%
0	1396	62	3026	55.8	4342	51.8
1	277	12.3	677	12.5	925	11
2	203	9	572	10.5	608	7.3
3	137	6.1	496	9.1	594	7.1
4	104	4.6	354	6.5	623	7.4
5	71	3.2	175	3.2	539	6.4
6	35	1.6	92	1.7	458	5.5
7	19	0.8	26	0.5	207	2.5
8	8	0.4	7	0.1	82	1
Total	2250	100	5425	100	8378	100

Source: Jayasinghe-Mudalige and Weersink (2004)

Table 49: National and Provincial Financial Assistance Programs Available for Selected BMPs

BMP Financial Assistance Specifications		
	National	Provincial Top-up
VRF	Precision farming applications under category 14 - 30% cost share for improved cropping systems to a maximum of $15,00026	
Minimum Tillage	Equipment modification for low disturbance placement of seed and fertilizer under category 14 (improved cropping systems) - cost share of 30% on specialized components up to maximum of $15,00027	
No Tillage	Equipment modification for low disturbance placement of seed and fertilizer under category 14 (improved cropping systems) - cost share of 30% on specialized components up to maximum of $15,00028	
NMP	Nutrient management planning under category 24 o cost share of 50% up to a maximum of $4,000	Manitoba - 25% provincial topup, to a maximum of $5,000 (totalling 75% to a maximum of
Add othe BMP's		

Sources:
1. Brethour et al., 2007

10 Estimates of Farmer Costs of Current Environmental Programs and Potential Abatement Costs for Canadian Cereals Growers

10.1 On-Farm Food Safety Plan and Environmental Farm Plan (Gray et al., 2005)

10.1.1 On-Farm Food Safety Plan

Table 50: Potential private costs of on-farm food safety plans in grain production

SUPPLY-SIDE COSTS	DESCRIPTION
Management and compliance costs	Compliance will require education and training. Many farmers have off-farm jobs, which can increase the opportunity cost of management Training OFFS will do very little to change the day-to-day operation of the farm. Farm operators recognize that pesticides and fertilizers are expensive and therefore already have an incentive to conserve on the use of these inputs. Spraying too close to harvest is normally very uneconomical. Farmers also have strong financial incentive to harvest grain in the best condition they can and to take measures to maintain its quality. The annual costs of recording information documenting good production practices and accompanying the inspector during visits will represent a substantial cost per acre Fixed costs may include upgrading or replacing grain storage to eliminate rodents, upgrading or replacing fertilizer storage, upgrading the septic system for the farm household and upgrading or replacing the pesticide spraying and fertilizer application equipment. These are potentially very large costs, which will tend to be highest for smaller farms operating with old capital. This may have implications for the structure of grain farms The requirements proposed as part of CGC's OFFS have much more to do with protection of the environment or an EFP, than they have to do with ensuring the safety of grain. The only potentially tangible benefit these investments would have for the safety of grain will be reduction in rodent droppings in the grain, which is a minute grain safety problem
Sunk investments	The extent that grain farmers will be captive to a particular supply chain will depend upon the degree to which the standards for the various OFFS are the same. If a national standard rather than a firm specific standard is developed, the producers will be able to negotiate with a number of buyers without being captive to a particular supply chain. In the organic industry many producer groups are advocating a national organic standard

Source: Gray et al. (2005)

Table 51: Costs of alternative on-farm food safety programs

	Voluntary industrywide OFFS	Enforced industry-wide OFFS	Buyer-specific OFFS	Regulatory standards
Management Costs				
fixed - establishing and the HACCP plan	Significant	Significant	Moderate	Moderate
variable - revising plan to reflect extreme changes	Significant	Significant	Minimal	Moderate
Compliance costs				
fixed - capital costs	Moderate	Very significant	Moderate	Moderate
variable	Very minimal	Minimal	Minimal	Minimal
Sunk investments				
risk of hold-up	Minimal	Minimal	Significant	None
Segregation costs				
fixed	Minimal	Moderate	Significant	None
variable	Minimal	Moderate	Significant	None
Monitoring and enforcement costs				
fixed	Minimal	Minimal	Minimal	Moderate
variable	Moderate	Very significant	Moderate	Moderate
Total costs	Moderate	Significant	Moderate	Minimal

Source: Gray et al. (2005)

10.1.2 Environmental Farm Plan

Table 52: Potential private costs of environmental farm plans in grain production

SUPPLY-SIDE COSTS	DESCRIPTION
Planning costs	Planning costs will primarily involve training costs and investment decisions to address problems. The ongoing costs will be very small. These costs will be nearly the same regardless of farm size
Management and mitigation costs	For producers with old farm buildings and equipment the implementation of an EFP may require significant investment A compulsory or a cross-compliance EFP will have a significantly greater financial impact on older, smaller farms

Source: Gray et al. (2005)

Table 53: Costs of alternative environmental farm plans

	Voluntary EFP	New building EFP	Annual EFP	Annual enforced EFP	Emission standards	Land use regulations
Management Costs						
fixed - establishing and the HACCP plan	Minimal	Moderate	Moderate	Significant	Moderate	Moderate
variable - revising plan to reflect extreme changes	Minimal	Moderate	Moderate	Significant	Moderate	Moderate
Monitoring and enforcement costs						
fixed - capital costs	Minimal	Moderate	Moderate	Moderate	Moderate	Moderate
variable	Minimal	Moderate	Significant	Very Significant	Significant	Moderate
Mitigation costs						
fixed - capital costs	Minimal	Moderate	Significant	Significant	Significant	Moderate
variable	Very Minimal	None	Minimal	Moderate	Very Minimal	Very Minimal
Segregation costs						
fixed	Moderate	Moderate	Moderate	Very Minimal	None	None
variable	Moderate	Moderate	Moderate	Very Minimal	None	None
Total costs	Minimal	Moderate	Moderate to Significant	Moderate to Significant	Moderate	Moderate to Minimal

Source: Gray et al. (2005)

10.2 Economic Analysis of Best Management Practices (George Morris Centre, 2007)

Brethour et al. (2006) from George Morris Centre prepared estimated farm profitability before and after participating in Best Management Practices using representative farm models from Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and Prince Edward Island. The representative farm models were developed using typical rotations for each province. In Ontario and Quebec, an even distribution of crops across the farm was assumed. Thus each of the major crops in the province – corn, wheat and soybeans -was planted in corn on 1/3 of the farm. Each year the distribution crops across the farm would change in "rotation" so that areas planted in soybeans in one year would be planted in corn or wheat in the next. For the black soil zones of Alberta and Saskatchewan it was assumed that 40% of the farm was planted in spring wheat, 30% in canola, 20% in barley and 10% in peas while the models for the brown soil zones in the two provinces the assumed distribution was 70% wheat, 15% lentils, and 15% barley. The authors note as a possible weakness the fact that the study represents only one year of a rotation.

The above representative models were combined with the 2006 crop budgets provided by the Provincial Governments and a survey of farmers on the impact of BMP's on farm costs and revenues to produce estimates of changes in expected net revenues basis due to the implementation of BMP's. The representative farm models were given a certain size (i.e. the average size of surveyed farms for each province) because costs in enterprise budgets were in per acre basis. The average farm sizes were: 1,358 acres in Alberta, 1,308 acres in

Saskatchewan, 1,525 acres in Manitoba, 430 acres in Ontario, 316 acres in Quebec, and 563 acres in Prince Edward Island.

The BMP's included in the survey were: soil testing, variable rate fertilization, manure management planning, buffer strips, no-till, and nutrient management planning. The authors selected these practices based on the review of previous literature. A practice was included in the model if it was not currently in use in an area and data on the costs of implementation were not readily available if it was believed that having this information would improve adoption. Farmers' interest in adoption of certain practices was also considered as a factor for selection.
The total of 39 models were run: 8 base models and 31 iterations of the models after implementation of BMP's. The models were run with and without financial assistance from the government available through National Farm Stewardship Program and Greencover program.

The study reports the effect of BMP's on net revenues but this is not appropriate for the purpose of this project. Therefore, we reconstructed the original calculations from the report and expressed the results as changes in net revenues as a percentage change in total costs. For example if net revenues after implementing a certain Best Management Practice decreased by $20/ha, and total costs before the implementation were $800/ha, this would, expressed as a percentage of total costs, would be reported as 2.5% increase. The following sections present the results of the study fro the above-mentioned Best Management Practices.

10.2.1 Soil Testing

Table 54 summarizes the effect of soil testing adoption on the expected farm net revenue. For most of the crops soil testing was estimated to have positive effects on the expected net revenue. This positive effect is the highest for corn in Ontario (i.e. 80% increase in net revenues). Soil testing had also large positive effect for the other two crops in Ontario – soybeans and witnter wheat, 39% and 37% respectively. But, it is important to note that these values are not that high in absolute terms. The dollar value of 80% increase in expected net revenue for corn is only 2.5% of total cost in corn produstion. The estimated effect of soil testing was also positive for Alberta, Saskatchewan and Manitoba. For most of the crops the positive change ranged from 3% to 36%, or from 1.2% to 10% of total cost, meaning that the given change in net revenue would be equivalent to a 1.2% to 10% decrease in total cost. Quebec was the only province where soil testing performed poorly in terms of farm profitability. It was estimated that introducing soil testing into the system would decrease net revenues by 1% for and 2% for soybeans. This would be equivalent to a 0.1 and 0.6 increase in total costs for the two crops. However, there was 9% increase in net revenues (1% decrease in total cost) for spring wheat. Thus, the overall rotational effect of soil testing for the whole rotation would still have a small positive effect, as it can be seen from the whole farm numbers (0.5% increase in net revenues equivalent 0.1% reduction in total cost). In summary, soil testing was estimated to be a practice that is beneficial for most of Canada not only for the environment but also with respect to farm profitability. At its worse, it had no effect on farm profitability.

Table 54: Summary of estimates in % changes in expected net revenue (and as % total cost) after participation in BMP's: case of soil testing

		Province					
Type of Cost	Crop	Alberta	Saskatchewan		Manitoba	Ontario	Quebec
		Brown	Black	Brown			
Per acre (without financial assistance)	Corn	-[1]	-		-	80 (2.6)	-1 (-0.1)
	Soybeans	-	-		-	39 (3.8)	-2 (-0.6)
	Winter wheat	-	-		-	37 (9.7)	-
	Barley	14 (3.8)[2]	3 (1.2)	-1 (-0.4)	26 (7.3)	-	-
	Canola	-	39 (9.2)		19 (7.9)	-	-
	Spring wheat	19 (7.1)	36 (7.2)	18 (6.0)	29 (10.0)	-	9 (1.0)
	Lentils	20 (7.5)		26 (7.5)	-	-	-
	Peas	-	2 (1.3)		15 (8.4)	-	-
Whole farm (without financial assistance)		18.9 (6.7)	15.3 (6.2)		11.5 (8.6)	59.3 (4.9)	0.5 (0.1)
Whole farm (with financial assistance)		18.9 (6.7)	15.3 (6.2)		11.5 (8.6)	59.3 (4.9)	0.5 (0.1)
Difference		0	0		0	0	0

Notes:

1. Not important crop for the province and thus not included in the model Based on Brethour et al. (2007)
2. Change in net revenue expressed as % of total cost

10.2.2 No-Till

Similar to soil testing use of No-till lead to increases in the expected net revenues. In fact, there were no losses estimated as a result of incorporating no-till into the production system. The best results in terms of changes in the expected net revenue were again in Ontario, where the expected net revenue increased by 84%, 49% for soybeans and 24% for winter wheat. Similar to the case of soil testing these numbers seem high doue to relatively low net revenues for the base model (which was …). This corresponded to 2.8%, 5.1%, and 6.2% decrease in total costs for the respective crops. The relative decrease in total costs (note that this does not necessarily mean that the costs of production decreased) was greater in Manitoba, 5.7% for barley, 4.8% for canola, 7% for spring wheat, and 9.4% for peas. The estimates for Quebec were somewhat lower than for Ontario and Manitoba but still fairly favourable. Introduction of no-till was expected to lead to 22% increase in net revenues for corn, 18% for soybeans, and 36% for spring wheat. This is equivalent to 2.5%, 3.3%, and 3.7% reduction in total cost for the respective crops. On the whole farm level basis introduction of no-till lead to 7.6% (in Quebec) to 22.7% (in Ontario) increase in the expected net revenue. Expressed as a percentage of total cost the effect of no-till was the highest in Manitoba (equivalent to 4.3% decrease in total cost) and lowest in Quebec (1.0%). As in the case of soil testing Quebec seems to be the least favourable province for adoption of no-till. This is indeed reflected in the low adoption rate of no-till practice in Quebec, shown in Table 38.

Table 55: Summary of estimates in % changes in expected net revenue (and as % of total cost) after participation in BMP's: case of no-till

		Province		
		Manitoba	Ontario	Quebec
per acre (without financial assistance)	corn	-[1]	84 (2.8)	22 (2.5)
	soybeans	-	49 (5.1)	18 (3.3)
	winter wheat	-	24 (6.2)	-
	Barley	21 (5.7)[2]	-	-
	canola	11 (4.8)	-	-
	Spring wheat	22 (7.0)	-	36 (3.7)
	peas	16 (9.4)	-	-
Whole farm (without financial assistance)		11.6 (4.3)	22.7 (1.9)	7.6 (1.0)
Whole farm (with financial assistance)		12.6 (4.6)	25.7 (2.2)	8.5 (1.1)
Difference		1 (0.3)	3 (0.3)	0.9 (0.1)

Notes:

1. Not important crop for the province and thus not included in the model Based on Brethour et al. (2007)
2. Change in net revenue expressed as % of total cost

10.2.3 Minimum Tillage

As in the case of no-till, using minimum tillage as compared to conventional tillage in the base model lead to favorable changes in net revenues for all crops in all provinces. The highest positive change was estimated for Ontario and Alberta. In Ontario Minimum tillage was expected to improve net revenues for all three crops in the model: corn (94%), soybeans (45%) and winter wheat (14%). While the effect of minimum tillage on the expected net revenue was somewhat lower than in Ontario (46% increase for barley, 42% for spring wheat and 27% for lentils), when these changes were expressed as a percentage of total costs the situation was more favorable in Alberta. The change in net revenues was equivalent to 12.7% reduction in total cost for barley, 15.4% reduction for spring wheat and 10.7% reduction for lentils. The respective changes for Saskatchewan are somewhat lower but still higher than in Manitoba, where introduction of minimum tillage was expected to be associated with net revenue change that would be equivalent to 4.7% reduction in total cost for barley, 6% for canola and 5.5 for spring wheat. Again, although still positive, the changes are least favorable in Quebec, where according to the farmers' expectations, adopting minimum tillage would lead to changes in net revenue equivalent to 2.3% reduction in total cost for corn, 3.3% reduction for soybeans and 4% reduction for spring wheat. It is interesting to note that the change in net revenues expressed as a percentage of total cost is lower (minimum tillage less beneficial in term sof farm profitability) for the eastern provinces. It is most favorable in Alberta, where it was estimated that minimum tillage would increase net revenues equivalent to 12% reduction in total cost. This is more than 7 times the estimated change for Quebec (1.6%), where adoption of minimum tillage seems least favorable in all of Canada. However, similar to the previous case of no-till t was not found that in any of the examined provinces minimum tillage would lead to losses in the expected net revenue.

Table 56: Summary of estimates in % changes in expected net revenue (and as % of total cost) after participation in BMP's: case of min-till

		Province				
		Alberta	Saskatchewan	Manitoba	Ontario	Quebec
		Brown	Brown			
per acre (without financial assistance)	corn	-[1]	-	-	94 (3.0)	20 (2.3)
	soybeans	-	-	-	45 (4.3)	16 (3.3)
	winter wheat	-	-	-	14 (3.5)	-
	Barley	46 (12.7)	12 (6.2)	18 (4.7)	-	-
	canola	-	-	14 (6.0)	-	-
	Spring wheat	42 (15.4)	27 (9.0)	17 (5.5)	-	40 (4.0)
	lentils	27 (10.7)	29 (8.1)	-	-	-
	peas	-	-	7 (4.2)	-	-
Whole farm (without financial assistance)		33.7 (12.0)	17.4 (6.1)	11.8 (4.4)	22.7 (1.8)	12.1 (1.6)
Whole farm (with financial assistance)		35.5 (12.5)	19.9 (7.1)	12.5 (4.8)	25.7 (2.1)	12.5 (1.6)
Difference		1.8 (0.5)	2.5 (1.0)	0.7 (0.4)	3 (0.3)	0.4 (0)

Notes:

1. Not important crop for the province and thus not included in the model
   Based on Brethour et al. (2007)

10.2.4 Variable Rate Fertilization

Unlike the previous three Best Management Practices, variable rate fertilization was not generally associated with increases in the expected net revenues. Furthermore there were much more regional differences with respect to the effect of introducing variable rate fertilization into the production process. Western provinces' farmers (Alberta and Saskatchewan) seemed to benefit from variable rate fertilization while the farmers in the easternmost province of the West, Manitoba as well as the eastern provinces Ontario and Quebec were expected to experience losses as a consequence of switching to variable rate fertilization. In Alberta, introduction of variable rate fertilization was estimated to rise the net expected revenue by 35% for barley, 65% for spring wheat, and 16% for peas. Similar to all the previous cases these figures become much lower when expressed as a percentage of the total cost (6% for barley, 9.2% for spring wheat and 4.4% for peas). The changes in the expected net revenues for Saskatchewan were comparable to those of Alberta. Unlike these two provinces, Manitoba farmers would experience losses due to introduction of variable rate technology. The expected net revenues for barley would decrease by 20%. For canola the reduction would be somewhat smaller, 12%, while only a small reduction of 4% was estimated for spring wheat. This would be equivalent to 5.7% increase in the total cost of production for barley, 4.8% increase for canola, and 1% increase for spring wheat. The corresponding figures for Ontario corn and soybeans were somewhat lower (2.1% reduction for corn and 5.1% reduction for soybeans) while the expected net revenue for winter wheat increased (equivalent to 3.9 reduction in total cost). Similar situation was in Quebec as with somewhat lower loses for corn (equivalent to 1.9% increase in total cost) and soybeans (equivalent to 3.8% increase in total cost) and lower gains for wheat (equivalent to 1.5 decrease in total cost). On the whole farm level the gains in net revenues were in the magnitude of 6-7% of the total cost, while the losses were minimal in Ontario and Quebec (0.7% and 0.9% of the total cost) and somewhat higher in Manitoba (2.3% of the total cost).

Figure 12: Results Of Ipsos Reid Survey Of BMPs in Ontario, 2006 – Farmers estimates of changes in revenues and costs as a result of

	Base Model	Soil Testing	VRF	Min Till	No-Till	NMP	Buffer Strips
Proportion of Cropland Using BMP (%):	0.0	100	59	52	44	100	3
Standard Deviation (σ)							
Number of respondents (n)			32	29	125		110
Estimated Changes to Yield (bu/ac):							
Corn	0.0	7.3	4.5	3.1	0.0	2.7	-4%
σ		6.1	5.8	5.4	5.0	5.4	6
n		43	24	17	93	46	110
Soybeans	0.0	2.2	1.1	0.6	-0.1	1.4	-4%
σ		3.2	2.2	1.5	4.1	3.4	6
n		43	20	14	99	34	110
Wheat	0.0	8.3	8.6	0.6	1.1	3.0	-4%
σ		5.2	5.5	1.8	5.2	4.3	6
n		9*	5*	8*	98	13	110
Estimated Changes to Operating Costs ($/ac):	0.0	0.2	3.6	-10.5	-17.6	-3.6	0.0
σ		16.3	22.4*	17.1	17.3	21.5*	
n		54	31	24	109	54	
*Estimates of Other Costs ($/ac)**:*							
Soil Testing Fee	0.0	3.1	0.0	0.0	0.0	0.0	0.0
σ							
n		48					
Custom Application Cost ($/BMP ac)	0.0	0.0	14.3	0.0	0.0	0.0	0.0
σ			11.1				
n			16				
Equipment Cost ($/BMP ac)	0.0	0.0	0.0	3.7	6.0	0.0	0.0
σ							
n				24	101		
Establishment Cost ($/BMP ac)	0.0	0.0	0.0	0.0	0.0	0.0	14.8
σ							
n							110
NMP Establishment Cost	0	0	0	0	0	1.1	0
Financial Assistance ($/ac):							
Financial Assistance from Government	0	0	0	0	0	0	0
n			33	29	126	64	110
Financial Assistance from Conservation Groups	0	0	0	0	0	0	0
n							110

† values based on producer estimates (Ipsos Reid, 2006)
* results may be impacted by small sample size (<10) or large standard deviation
** all estimated BMP costs were amortized
BMP - Beneficial Management Practice(s)
NMP - Nutrient Management Plan
Source: Ipsos Reid Survey, 2006

Source: Adopted from Brethour et al. (2007)

Figure 13: Economic comparison of BMP for corn, soybeans and wheat in Ontario

Corn

	Base Model	Soil Testing	VRF	Min Till ($/ac)	No-Till	NMP	Buffer Strips
Total Revenue	415	436	428	424	415	423	399
Total Variable Costs	381	390	403	376	369	380	391
Total Fixed Costs	49	49	49	49	49	49	49
Total Expenses	429	439	451	425	417	429	440
Expected Net Revenue	-14	-3	-23	-1	-2	-6	-41
Change in Expected Net Revenue from Base (%)	**n/a**	**80**	**-66**	**94**	**84**	**56**	**-190**

Soybeans

	Base Model	Soil Testing	VRF	Min-Till ($/ac)	No-Till	NMP	Buffer Strips
Total Revenue	258	272	265	262	258	267	248
Total Variable Costs	183	187	202	176	171	181	197
Total Fixed Costs	53	53	53	53	53	53	53
Total Expenses	235	240	254	229	223	234	249
Expected Net Revenue	23	32	11	33	34	33	-1
Change in Expected Net Revenue from Base (%)	**n/a**	**39**	**-53**	**45**	**49**	**45**	**-106**

Wheat

	Base Model	Soil Testing	VRF	Min Till ($/ac)	No-Till	NMP	Buffer Strips
Total Revenue	325	355	356	327	329	336	315
Total Variable Costs	196	201	217	189	184	194	211
Total Fixed Costs	63	63	63	63	63	63	63
Total Expenses	259	264	280	252	247	257	274
Expected Net Revenue	66	90	76	75	82	79	41
Change in Expected Net Revenue from Base (%)	**n/a**	**37**	**15**	**14**	**24**	**19**	**-38**

Source: Adopted from Brethour et al. (2007)

Table 57: Summary of estimates in % changes in expected net revenue (and as % of total cost) after participation in BMP's: case of variable rate fertilization

		Province				
		Alberta	Saskatchewan	Manitoba	Ontario	Quebec
		Black	Black			
per acre (without financial assistance)	corn	-[1]	-	-	-66 (-2.1)	-17 (-1.9)
	soybeans	-	-	-	-53 (-5.1)	-18 (-3.8)
	winter wheat	-	-	-	15 (3.9)	-
	Barley	36 (6.0)	14 (5.0)	-20 (-5.7)	-	-
	canola	-	30 (7.6)	-12 (-4.8)	-	-
	Spring wheat	65 (9.2)	56 (10.8)	-4 (-1.0)	-	16 (1.5)
	lentils	-	-	-	-	-
	peas	16 (4.4)	12 (5.7)	-13 (-6.8)	-	-
Whole farm (without financial assistance)		52.7 (6.2)	25.2 (6.6)	-6.6 (-2,3)	-9.1 (-0.7)	-6.4 (-0.9)
Whole farm (with financial assistance)		57 (6.8)	27.7 (7.3)	-3.5 (-1.1)	-9.1 (-0.7)	-6.4 (-0.9)
Difference		4.3 (0.6)	2.5 (0.7)	3.1 (1.2)	0 (0)	0 (0)

Notes:

1. Not important crop for the province and thus not included in the model

Source: Brethour et al. (2007)

10.2.5 Nutrient Management Plan

As indicated earlier farming systems both in the West and East are characterized by mixed grain and livestock production. Thus, nutrient management plan is a potentially important environmentally beneficial management strategy. Table 58 summarizes the estimated changes in the expected net revenue for a representative farm in Alberta, Saskatchewan, Manitoba, Ontario and Quebec. In Saskatchewan and Alberta both brown and black soil types were included in the analysis. It is evident from the table that having a nutrient management plan was estimated to be a beneficial management strategy for all provinces, all crops, and all soil types. In terms of percentage changes in net revenue, nutrient management plan produced the highest increase for Alberta and Saskatchewan spring wheat in the black soil zone (62% and 58% respectively), followed by Ontario corn (56%), Saskatchewan canola on black soil (55%), and Ontario soybeans (45%). This was equivalent to 8.7% decrease in total cost of production for the Alberta, 11.4% decrease for the Saskatchewan wheat, only 1.9% decrease for Ontario corn, 13.5% decrease for the Saskatchewan canola, and 4.3% decrease for Ontario soybeans. The largest change in net revenues relative to the total cost of production, 13.8%, was observed for Alberta lentils in the brown soil zone. Next was already mentioned Saskatchewan canola on black soil, followed by Saskatchewan spring wheat on brown (12%) and black (11.4%) soil and Alberta spring wheat on brown soil (11.2%). On the whole farm level, the best results were expected to be achieved in the Alberta black soil zone, where the estimated change in the expected net revenue was 77.9%. This would be equivalent to a 9.2% decrease in the total cost of production in the base model. Even though the percentage change in the expected net revenue was lower, when expressed as a share of total cost this change was higher than 9.2% for the Alberta brown soil zone (11.5%) and for the Saskatchewan black (10.1%) and brown (10.5%) soil zones.

Table 58: Summary of estimates in % changes in expected net revenue (and as % of total cost) after participation in BMP's: case of Nutrient Management Plan

		Province						
		Alberta		Saskatchewan		Manitoba	Ontario	Quebec
		Black	Brown	Black	Brown			
per acre (without financial assistance)	corn		-[1]		-	-	56 (1.9)	9 (1.1)
	soybeans		-		-	-	45 (4.3)	13 (2.5)
	winter wheat		-		-	-	19 (5.0)	-
	Barley	34 (6.0)	28 (8.3)	14 (5.0)	3 (2.3)	20 (5.2)	-	-
	canola	n/a	n/a[1]	55 (13.5)		18 (7.5)	-	-
	Spring wheat	62 (8.7)	33 (11.2)	58 (11.4)	36 (12.0)	26 (8.0)	-	20 (2.1)
	lentils		34 (13.8)		43 (11.2)	-	-	-
	peas	9 (2.2)		7 (3.1)		9 (5.2)	-	-
Whole farm (without financial assistance)		77.9 (9.2)	32.6 (11.5)	38.4 (10.1)	30.3 (10.5)	19.6 (7.1)	41.3 (3.4)	12.7 (1.8)
Whole farm (with financial assistance)		79.2 (9.4)	33.2 (11.6)	39.3 (10.3)	31.2 (10.6)	20.2 (7.5)	43.7 (3.7)	13.6 (1.9)
Difference		1.3 (02)	0.6 (0.1)	0.9 (0.2)	0.9 (0.1)	0.6 (0.4)	2.4 (0.3)	0.9 (0.1)

Notes:

1. Not important crop for the province and thus not included in the model
2. % change was not calculated because the base expected net revenue was zero.

Based on Brethour et al. (2007)

10.2.6 Buffer Strips

Unlike the Nutrient Management Plan, introducing buffer strips lead to decreases in the expected net revenue for al crops in all provinces. This is, actually, expected since this management strategy involves taking land out of production. The model did not assume any revenues from grass (in case of grass buffer strips) or wood (in case of tree buffer strips). Even though net revenue losses were quite high for some crops in certain provinces, the overall effect on farm profitability was low because even though the field right next to the stream would experience a noticeable drop in yields, only small proportion of total farm cropland areas would be taken out of production (i.e. along the waterways). For some crops losses in the expected net revenue were extremely high: 105% for Alberta black soil zone spring wheat and 78% for barley, 190% for Ontario corn and 106% for soybeans. Expressed as a percentage of total cost these losses were equivalent to 14.7% increase in total cost of the base model for the Alberta wheat, 14.9% increase for barley, 6.3% increase for Ontario wheat and 10.2% increase for soybeans. Other cases where the loss of expected net revenue as a share of total cost was high were peas in Alberta (13.3%), canola in Manitoba (10.4%) and winter wheat in Ontario (9.7%). Prince Edward Island was included in the George Morris Centre (2006) study but is not relevant for our report since the estimates are related to potato production, which is the major field crop in the province.

On the whole farm level the losses in the expected net revenue are the highest in Alberta (10.1%). Next is Ontario with estimated 3% losses, followed by Quebec with 1.9% losses and Manitoba with 1.2%. Expressed as percentage of the total cost these losses are less than 1% for all provinces except Alberta (1.1%) but with government financial assistance this figure falls to 0.9%.

Table 59: Summary of estimates in % changes in expected net revenue after participation in BMP's: case of buffer strips

		Province					
		Alberta	Manitoba	Ontario	Quebec	Prince Edward Island	
		Black					
per acre (without financial assistance)	corn	-[1]	-	-190 (-6.3)	-38 (-4.4)	-	
	soybeans	-	-	-106 (-10.2)	-38 (-7.7)	-	
	winter wheat	-	-	-38 (-9.7)	-	-	
	Barley	-78 (-14.9)	-35 (-10.4)	-	-	-	
	canola	n/a[1]	-20 (-7.9)	-	-	-	
	Spring wheat	-105 (-14.7)	-29 (-9.0)	-	-55 (-5.4)	-	
	lentils	-	-	-	-	-	
	peas	-42 (-13.3)	-14 (-7.3)	-	-	-	
	potatoes	-	-	-	-	-12 (-4.2)	
Whole farm (without financial assistance)		-10.1 (-1.1)	-1.2 (-0.4)	-3 (-0.25)	-1.9 (-0.3)	-0.6 (-0.21)	
Whole farm (with financial assistance)		-8.2 (-0.9)	-1 (-0.3)	-2.1 (-0.17)	-1.3 (-0.2)	-0.5 (-0.18)	
Difference		1.9 (0.2)	0.2 (0.1)	0.9 (0.08)	0.6 (0.1)	0.1 (0.03)	

Notes:

1. Not important crop for the province and thus not included in the model
2. % change was not calculated because the base expected net revenue was zero.

Based on Brethour et al. (2007)

Table 60: Provincial whole farm results: % change from the base model without and with financial assistance

	Soil Testing	VRF	Min-Till	No-Till	NMP	Buffers
Alberta-Black	-[1]	53% (57%)	-	-	78% (79%)	-10% (-8%)
Alberta-Brown	19% (19%)[2]	-	34% (35%)	-	33% (33%)	-
Sask-Black	24% (24%)	25% (28%)	-	-	38% (39%)	-
Sask-Brown	15% (15%)	-	17% (12%)	-	30% (31%)	-
Manitoba	12% (12%)	-7% (-3%)	12% (12%)	12% (13%)	20% (20%)	-1% (-1%)
Ontario	59% (59%)	-9% (-9%)	23% (26)	23% (27%)	42% (44%)	-3% (-2%)
Quebec	1% (1%)	-6% (-6%)	12% (13%)	8% (9%)	13% (14%)	-2% (-1%)
PEI	-	-	-	-	-	-0.6% (-0.5%)

Notes:
1. Not examined
2. % change was not calculated because the base expected net revenue was zero.

Based on Brethour et al. (2007)

Table 61: Provincial whole farm results: change in net expected revenue from the base model without and with financial assistance expressed as % of total cost

	Soil Testing	VRF	Min-Till	No-Till	NMP	Buffers
Alberta-Black	-[1]	6.0% (6.8%)	-	-	9.2% (9.4%)	-1.1% (-0.9%)
Alberta-Brown	6.7% (6.7%)[2]	-	12.0% (12.5%)	-	11.5% (11.6%)	-
Sask-Black	6.2% (6.2%)	6.6% (7.3%)	-	-	10.1% (10.3%)	-
Sask-Brown	5.4% (5.4%)	-	6.1% (7.1%)	-	10.5% (10.6%)	-
Manitoba	8.6% (8.6%)	-2.3% (-1.1%)	4.4% (4.8%)	4.3% (4.6%)	7.1% (7.5%)	-0.4% (-0.3%)
Ontario	4.9% (4.9%)	-0.7% (-0.7%)	1.8% (2.1%)	1.9% (2.2%)	3.4% (3.7%)	-0.3% (-0.2%)
Quebec	0.1% (0.1%)	-0.9% (-0.9%)	1.6% (1.6%)	1.0% (1.1%)	1.8% (1.9%)	-0.3% (-0.2%)
PEI	-	-	-	-	-	-0.2% (-0.2%)

Notes:
3. Not examined
4. % change was not calculated because the base expected net revenue was zero.

Based on Brethour et al. (2007)

10.3 Estimates of Potential Pollution Abatement Costs for Canadian Cereal Growers

10.3.1 Groundwater and Nitrogen

- southwestern Ontario; corn-wheat-soybean rotation
- cost to reduce groundwater nitrates to less than 10 ppm

Giraldez and Fox (1995) found that the cost of reducing nitrates in groundwater used for drinking in southwestern Ontario village of Hensel can be as low as $1.8/ha.

Table 62: Nitrogen application rates, estimated yields and nitrogen exports in grain for fields in the study area

Field	Nitrogen application rate	Estimated yield	Estimated nitrogen exports in grain corn
	(kg N/ha/yr)	(kg corn/ha/yr)	(kg N/ha/yr)
1	175	9387	150.75
2	125	9110.8	146.32
3	160	9354.1	150.23
4	90	8634.6	138.67

Source:
Giraldez and Fox, 1995

Table 63: Effectiveness of agricultural practices in reducing nitrate pollution as predicted by CREAS (three-year totals)

Agricultural Practice	Nitrogen in surface runoff	Nitrate leached out of the rootzone	Change in nitrogen in surface runoff	Change in nitrate leached out of the rootzone
(147 kg N/ha/yr)	(kg/ha)	(kg/ha)	(%)	(%)
Base practice	34.96	55.05	-	-
Winter cover/crop residue management	30.93	54.43	-11.53%	-1.12%
Conservation tillage (chisel plow)	31.61	55	-9.58%	-0.1
Contour/conservation tillage	28.44	55.19	-18.65%	-0.25

Source:
Giraldez and Fox, 1995

Table 64: Studies estimating potential pollution abatement costs for nitrates in groundwater originating from field crop production

	Policy Instruments	Management Practices	General Findings	Abatement Cost	% of total cost
Fox et al., 1995	nitrogen application limit; tax on nitrogen fertilizer	reduced nitrogen fertilizer use	Nitrogen application limit much less costly than tax on nitrogen. In this particular case cost is low but it can be much higher if greater reductions in N use are needed.	$1.8/ ha if limiting N use; 49.7/ha if imposing a nitrogen tax	0.2-7
Weersink, et al., 1998	performance standards; design standards; performance tax; design tax	crop selection; input use	Standards much less costly than taxes; pricing strategies change costs but not dramatically; risk attitudes important	$9-$113/ha depending on policy instrument, pricing scenario, and risk aversion level	1-16
Yiridoe and Weersink, 1998	leaching limits; cost sharing	crop choice, crop rotation, and tillage treatment,	Choice of a cost-effective farming system for mitigating nitrate leaching is more critical under more stringent standards than at higher pollution levels.	$25-$52/ha	3-7

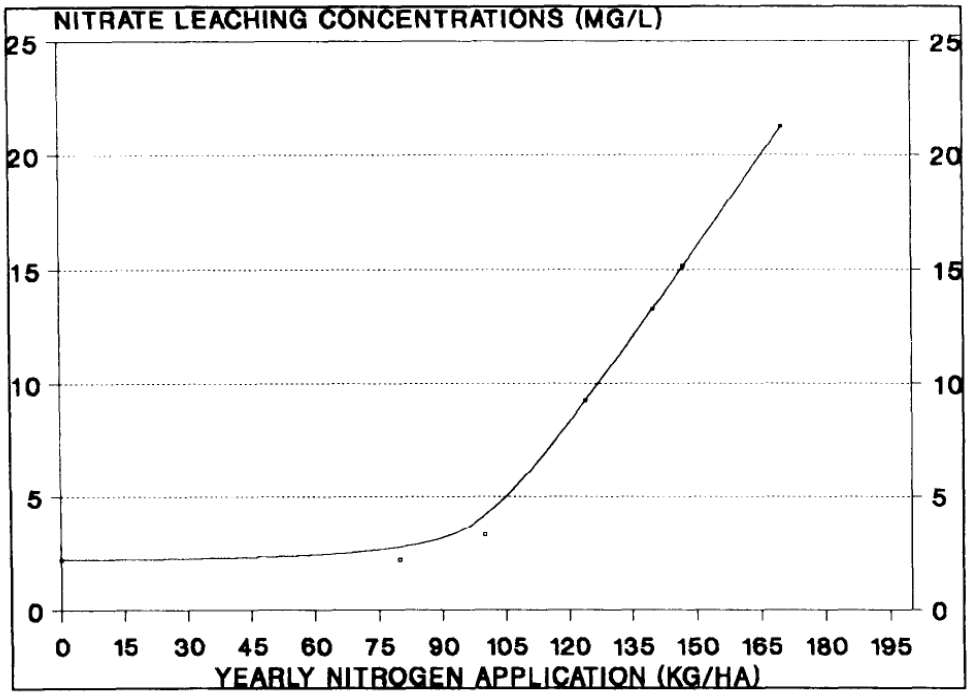


Figure 3. CREAMS simulation results, showing the yearly average effect of reducing nitrogen applications on the total level of nitrate leaching (top) and on the concentration in the water leaching (bottom)

Figure 14: CREAMS simulation results, showing the yearly average effect of reducing nitrogen applications on the total level of nitrate leaching (top) and on the concentration in the water leaching (bottom)

Rajsic (2007) estimated yield response curves using four yield response functional forms (linear-plateau, quadratic-plateau, Mitscherlich, and quadratic) for seven randomized complete block nitrogen trials on corn, conducted in five counties in southwestern Ontario (Haldinand-Norfolk, Elgin, Middlesex, Kent, and Essex), selected from the dataset used in Janovicek et al. (2004). The experiments were conducted between 1989 and 2001. The time period in which six of the experiments overlapped was from 1990 to 1992. Two of the experiments contained multi-year data (i.e. 9 and 6 years).
Corn heat units within the experimental area ranged from 3000 to 3400. There was also some heterogeneity in terms of soil texture, which included sand, loamy sand, sandy loam, loam, and clay loam. Soil in two of the experiments was well drained while the rest had either imperfect or poor drainage. Fields in all seven experiments were planted in corn in the previous year and there were no cover crops. All fields were tilled. Moldboard was used in five of the experiments and mulch-till in two. Fall was the predominant tillage time. Two fields were tilled in spring. One field was fertilized with urea-ammonium nitrate, while the six other fields were fertilized with anhydrous ammonia. Fertilizer was side dressed, coulter or knife injected. Yield at 5 or 6 nitrogen application

rates between 0 and 262 kg N per hectare was recorded. There were 8 replications per treatment in one experiment and 4 in the other six experiments.
After estimating yield response functions it is possible to calculate per acre profit resulting from applying alternative nitrogen rates for a given site in a given year by using. Currently farmers in Ontario are provided with Ontario Nitrogen Calculator, a publicly available online tool for determining the supposedly approximate economically optimal nitrogen rate (nitrogen rate for maximum profit) for a field with a specific yield potential, soil texture and corn heat units, by also taking into account previous crop, fertilizer type, application method and price as well as corn price. As a result, farmers get nitrogen recommendations that should achieve close to maximum profit for a given field. There is an ongoing debate whether the calculator is actually producing reliable estimates of economically optimal nitrogen rates but this is outside of the scope of this report.

Table 65 shows the change in net revenue for six sites over three years as a result of limiting the in nitrogen recommendations suggested by the Ontario Nitrogen Calculator to 170 kg/ha, the current nitrogen limit in force in the E.U. In other words, it shows by how much would a farmer's net revenue change if he/she applied the recommended nitrogen rate only if it was lower than 170 kg/ha. Otherwise they would have to apply no more than the nitrogen rate limit regardless of the recommendation. The changes are expressed both in dollar terms and as a percentage of total cost. Most of the times the 170 kg/ha nitrogen limit was higher than the actual recommendation for a site. These cases are displayed as 0 in the table. Only on two sites the nitrogen limitation caused more than $10/ha profit loss. Even though the net revenue losses for both sites can be considered significant, up to $21 and $72/ha, which is about 1/5 and 1/2 of the average per hectare net revenue in Ontario for owned land, ***(crop budgets)*** on average, across all sites and years, the losses are minimal (i.e less than $5/ha or 0.5% of total cost of production). The estimated revenue loss depended on the assumed yield response functional form (note that all four forms fitted the yield data equally well) but the estimated losses were so low that the yield response functional form does not make much difference. Namely, the difference between the lowest estimate suggested by the linear-plateau form and the highest, suggested by the quadratic form was $4 or 0.4% of the total cost of production.

Table 65: Change in net revenue over 3 years on 6 sites in southwestern Ontario as a result of limiting the nitrogen recommendation to 170 kg/ha

		Yield response Functional Form						
Site	Year	Linear-Plateau		Quadratic-Plateau		Mitscherlich		Quadratic
		$/ha	% of total cost	$	% of total cost	$	% of total cost	$	% of total cost
289	199026	2.9	-4	-0.4	-1	-0.1	-6	-0.7
	1991-35	-3.8	-56	-6.0	-54	-5.8	-56	-6.0
	1992-72	-7.8	-39	-4.2	-40	-4.4	-39	-4.2
290	19900	0.0	0	0.0	0	0.0	0	0.0
	19910	0.0	0	0.0	0	0.0	0	0.0
	19920	0.0	0	0.0	0	0.0	0	0.0
292	19903	0.3	3	0.3	3	0.3	3	0.3
	19913	0.4	3	0.4	3	0.3	5	0.5
	19923	0.4	3	0.4	0	0.1	-1	-0.1
298	19900	0.0	0	0.0	0	0.0	0	0.0
	19910	0.0	0	0.0	0	0.0	0	0.0
	19920	0.0	0	0.0	0	0.0	0	0.0
299	19900	0.0	0	0.0	0	0.0	0	0.0
	19910	0.0	10	1.1	0	0.0	0	0.0
	19920	0.0	0	0.0	0	0.0	0	0.0
300	199020	2.2	20	2.2	14	1.5	12	1.3
	199120	2.2	21	2.3	-6	-0.7	-7	-0.7
	199220	2.2	3	0.4	6	0.6	3	0.3
Average		-1	-0.1	-2	-0.2	-4	-0.5	-5	-0.5

10.3.2 Soil Quality (Erosion and Surface Water): Ontario and Quebec

Table 66: Studies estimating potential abatement cost of reduction in surface water sediment loading originating from field crop production

	Region	Cropping Practices	General Findings	Pollution Reduction	Abatement Cost	
					$/ha	% of total cost
Dissart, et al., 2000	Quebec	crop selection (more hay); reduced tillage	farms with higher net incomes would be better off if the erosion target value were set at the watershed level, while farms with lower net incomes would be worse off.	20% - 53%	$11 - $68/ha	1.5-10
Fox et al., 1995	Southwestern Ontario	reduced tillage; alternative crop rotations;grass buffer strips;	physical characteristics may be used as proxy criteria for identifying farmland that contributes the most to off-farm water quality damage; this would improve the cost effectiveness of conservation policies	70%-80%	$6-$34/ha/yr	1-5
Yang and Weersink, 2004	Southwestern Ontario	riparian buffers;	marginal abatement costs the most relevant for setting the abatement target; a cost-effective land retirement program allows the width of vegetation buffer to vary by location; land retired represents a small portion of total land ; thus reduction in fixed machinery costs should not be included in the benefits from retirement	10% - 50%	$175-$306/ha	25-43
Yang, et al., 2005	Soutwestern Ontario	Conservation Tillage	Sediment abatement and carbon retention can be achieved at the same time; extent of both varies significantly locally; setting sediment targets more cost-effective way of achieving both	23 -40% carbon emission; 20 - 35% sediment loading	$26 - $29/ha	
Delaporte, 2007	Soutwestern Ontario	Conservation tillage, wetland preservation	Considering only wetland drainage decisions and a single ecological constraint, agricultural returns could increase greatly with relatively low amounts of wetland drainage. The addition of croplands allows higher sediment abatement goals to be reached at lower cost, or equal sediment abatement goals to be reached with higher returns. The inclusion of multiple ecological restraints limits potential agricultural returns. If multiple goals are considered and one cannot be decreased, then no agricultural returns can be realized.	Up to	$0 - $113/ha	

10.3.3 Greenhouse Gasses

Table 67: Studies estimating costs of greenhouse gases emission abatement

Author(s)	Region/Province	Changes in Farm Practices Involved	Environmental Indicator Change Level(s)/Targets	Abatement Cost	
			(%)	($/ha)	% of increase in total cost**
Gheidi, 1997	Saskatchewan	input use	12.5% increase in SOM	$43.77/ha	11
Freeze and Peters, 1999	Alberta	running a ethanol feedlot as opposed to selling wheat to The Wheat Board	-	$168/ha - $375/ha	41-93
Manley et al., 2005	Prairies	Conservation Tillage	-	$40-$100/ha*	10-25
Smith and Upadhyay, 2005	Prairies	crop rotation; crop mix; minimum tillage; reduced fertilizer application	10% reduction in CO2 eq.	$32-$273/ha*	8-67
Meyer-Aurich et al., 2006	Ontario	reduced tillage; crop rotation; input use	15% reduction in CO2 eq.	$110/ha	15

10.3.4 Multiple Emissions

Table 68: Studies estimating potential abatement cost of achieving multiple environmental goals

	Pollutant	**Changes in Farm Practices Involved**	Rduction in sediment loading	Abatement Cost	
			(%)	($/ha)	% Increase in total costs
Delaporte, 2007	Erosion and wildlife protection	No till, riparian (wetland) buffer protection	% change in water quality score and wildlife score		
Yang, et al., 2005	erosion and greenhouse gas emissions	Conservation Tillage	23 -40% carbon emission; 20 - 35% sediment loading	$26 - 29/ha	4
LINTNER and WEERSINK, 1999	nitrates and phosphorous	no-till; reduced fertilizer use; crop rotation	20% reduction in phosphate concentrations; nitrates did not exceed 10 mg/l	$11/ha	1.5
Delaporte, 2007	Erosion and wildlife protection	No till, riparian (wetland) buffer protection	% change in water quality score and wildlife score		0 – 1.9

Delaporte (2007) used an integrated economic, hydrologic and GIS models to examine the effect of conservation tillage and wetland preservation on sediment abatement and wildlife protection in the Eramosa Watershed in southwestern Ontario and to estimate foregone agricultural returns as a consequence of sediment abatement and wildlife preservation.
The Eramosa Watershed, part of the Grand River Watershed, is approximately 276 km^2 in size, and spans over the County of Wellington, the City of Guelph and the Regional Municipality of Halton. Over 60 percent of the land in the watershed is used for agricultural purposes. A third of the land forested and about 4 percent of the land in the watershed is under urban areas, such as the Towns of Erin and Rockwood and the City of Guelph. About 47 km^2, or 16.6 percent of the watershed area, is composed of wetlands. Five different wetland preservation models, with different levels of complexity, are used in the study: the Water Quality and Wetland Model (WQWL), the Wildlife Habitat and Wetland Model (WHWL), the Water Quality, Wetland and Agricultural Land Model (WQWLAG), the Water Quality, Wildlife Habitat and Wetland Model (WQWHWL), and the Full Model. The first two models incorporate a single ecological constraint and agricultural returns from a drainage decision in wetland areas. The third model incorporates the sediment erosion reduction and agricultural returns from a drainage decision in wetland areas and a tillage decision in cropland areas. The fourth model considers the wetland drainage decision with both of the ecological constraints. The final model, the Full Model, incorporates all of the considered factors, a wildlife habitat constraint, a water quality constraint, and wetland drainage and tillage decisions, in wetlands and agricultural areas, respectively.

The results from the WQWHWL model exemplify the tradeoffs between agricultural returns, and sediment abatement and wildlife habitat provision goals when the only management decision is to drain or not to drain certain wetlands. In other words conservation tillage is not considered as a substitute for wetland drainage in this model. Table 69 was derived from the estimated agricultural returns after converting 56 wetland areas into cropland. The situation before any decision has been made is when no wetlands have been drained, thus the wildlife habitat constraint is at 100%, and agricultural returns are zero since no land has been converted to cropland. Wetlands are being chosen for drainage on the basis of their sediment abatement potential and wildlife habitat score so that the wildlife habitat constraint and sediment abatement constraint are being met while maximizing agricultural returns from the drained wetlands. The model suggested that 51 wetlands need to be drained to maximize agricultural returns. Reducing the number of drained wetlands below 51 leads to decreases in agricultural returns compared to the maximum returns. In a sense the foregone agricultural returns resulting from “saving” a wetland can be viewed as an opportunity cost of wetland preservation. The cost of wetland drainage (removal of water, trees, installation of tile drains) was also taken into account. The fact that a certain wetland was chosen to be drained by the model implies that the agricultural income from the drained wetland exceeded the costs of drainage.

The table shows that the costs of wetland preservation reaches 1.9% of total average Ontario farm cost at its maximum (all wetlands preserved). The cost decreases to below 1% (0.9%) when the wildlife habitat constraint is relaxed to 70% and the water quality

constraint to 80%. It falls further, under 0.5% at when both constraints are reduced to 50%.

It is interesting to note that there is a certain degree of substitutability of wetland preservation and sediment abatement. For example, the cost of achieving 60% of both constraints is $4.8/ha. However it is possible to achieve more than 60% of the sediment abatement constraint, at the same cost, by reducing the wildlife constraint to 50%. This is evident from the fact that the wildlife habitat constraint of 50% and the sediment abatement constraint between 60% and 70% can be achieved at cost between $4/ha and $5.2/ha.

Introducing conservation tillage as an additional management practice aimed at sediment reduction can lower the cost of both sediment abatement and wildlife habitat preservation. Conservation tillage is a much cheaper strategy for sediment abatement than wetland buffers. Thus, wetlands with higher wildlife habitat potential and wetlands with higher agricultural productivity can be preserved even though their sediment abatement potential is not high. This is illustrated in Table 69. Status quo sediment abatement level is equivalent to 100% sediment abatement constraint (no wetlands drained) level in Table 69. It is evident that both maximum wildlife habitat constraint and 100% of sediment abatement constraint from Table 69 can now be achieved with foregone agricultural returns under 1% (0.89%) of the total cost of production. Furthermore it is possible to increase.

However, foregone income as a consequence of taking out land from production is not the only cost of preserving wildlife habitats. There may be other investments and activities that need to be done (i.e. building shelters, decreased use of machinery, protecting crops from wildlife damage etc.) which were not the focus of Delaporte's study. Next Table looks at actual dollars spent by the federal and provincial governments and farmers on management practices aimed at preserving wildlife and enhancing biodiversity.

Table 69: Summary of foregone agricultural returns (in $/ha1, and in % of total cost2 of production) of the 10 wildlife habitat and water quality constraint levels.

	Wildlife Habitat Constraint (%)																					
Water Quality Constraint (%)	**100**		90		80		70		60		50		40		30		20		10		0	
	$/ha	% of total Cost	$/ha	% of total Cost	$/ha	% of total Cost	$/ha	% of total Cost	$/ha	% of total Cost	$/ha	% of total Cost	$/ha	% of total Cost	$/ha	% of total Cost	% of total Cost	$/ha	% of total Cost	$/ha	% of total Cost	
100	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%	$14.5	1.9%
90	$14.5	1.9%	$11.2	1.4%	$9.8	1.3%	$9.7	1.3%	$9.7	1.3%	$9.7	1.3%	$9.7	1.3%	$9.7	1.3%	$9.7	1.3%	$9.7	1.3%	$9.7	1.3%
80	$14.5	1.9%	$11.0	1.4%	$8.5	1.1%	$7.3	0.9%	$7.2	0.9%	$7.2	0.9%	$7.2	0.9%	$7.2	0.9%	$7.2	0.9%	$7.2	0.9%	$7.2	0.9%
70	$14.5	1.9%	$11.0	1.4%	$8.2	1.1%	$6.5	0.8%	$5.6	0.7%	$5.2	0.7%	$5.2	0.7%	$5.2	0.7%	$5.2	0.7%	$5.2	0.7%	$5.2	0.7%
60	$14.5	1.9%	$11.0	1.4%	$8.2	1.1%	$6.1	0.8%	$4.8	0.6%	$4.0	0.5%	$3.9	0.5%	$3.9	0.5%	$3.9	0.5%	$3.9	0.5%	$3.9	0.5%
50	$14.5	1.9%	$11.0	1.4%	$8.2	1.1%	$5.8	0.8%	$4.3	0.5%	$3.4	0.4%	$2.8	0.4%	$2.7	0.4%	$2.7	0.3%	$2.7	0.3%	$2.7	0.3%
60	$14.5	1.9%	$11.0	1.4%	$8.2	1.1%	$5.8	0.7%	$4.2	0.5%	$2.9	0.4%	$2.1	0.3%	$1.8	0.2%	$1.7	0.2%	$1.7	0.2%	$1.7	0.2%
50	$14.5	1.9%	$11.0	1.4%	$8.2	1.1%	$5.8	0.7%	$4.2	0.5%	$2.8	0.4%	$1.8	0.2%	$1.1	0.1%	$0.9	0.1%	$0.9	0.1%	$0.9	0.1%
40	$14.5	1.9%	$11.0	1.4%	$8.2	1.1%	$5.8	0.7%	$4.2	0.5%	$2.8	0.4%	$1.6	0.2%	$0.6	0.1%	$0.5	0.1%	$0.3	0.0%	$0.3	0.0%
30	$14.5	1.9%	$11.0	1.4%	$8.2	1.1%	$5.8	0.7%	$4.2	0.5%	$2.8	0.4%	$1.6	0.2%	$0.6	0.1%	$0.3	0.0%	$0.0	0.0%	$0.0	0.0%
20	$14.5	1.9%	$11.0	1.4%	$8.2	1.1%	$5.8	0.7%	$4.2	0.5%	$2.8	0.4%	$1.6	0.2%	$0.6	0.1%	$0.3	0.0%	$0.0	0.0%	$0.0	0.0%

Notes:

1. total agricultural returns divided by the agricultural area in the watershed (27600 ha, assuming 60% of the watershed area is agricultural)
2. total cost of production: average total cost for a 3-year corn-wheat-soybean rotation, according to 2007 OMAFRA crop budgets was $744/ha

Table 70: Summary of the agricultural returns of the 11 wildlife habitat constraint levels, at 100 and 300 percent of the maximum wetland sediment abatement goal when conservation tillage is included in the model

	Total Returns For the Watershed		Returns Per Hectare of Status Quo Agricultural Land		Foregone Returns per hectare of Status Quo Area		Foregone Returns as % of total cost	
Wildlife Habitat Constraint (% of Maximum)	Status Quo Sediment Abatement Level	Maximum Sediment Abatement Level (300% of Status Quo level)	Status Quo Sediment Abatement Level	Maximum Sediment Abatement Level (300% of Status Quo level)	Status Quo Sediment Abatement Level	Maximum Sediment Abatement Level (300% of Status Quo level)	Status Quo Sediment Abatement Level	Maximum Sediment Abatement Level (300% of Status Quo level)
100	3,472,421	3,210,845	75.5	69.8	6.9	12.6	0.89	1.62
90	3,556,569	3,273,626	77.3	71.2	5.1	11.2	0.65	1.45
80	3,624,399	3,318,216	78.8	72.1	3.6	10.2	0.46	1.32
70	3,670,869	3,329,839	79.8	72.4	2.6	10.0	0.33	1.29
60	3,709,983	3,329,839	80.7	72.4	1.7	10.0	0.22	1.29
50	3,737,102	3,329,839	81.2	72.4	1.1	10.0	0.15	1.29
40	3,761,871	3,329,839	81.8	72.4	0.6	10.0	0.08	1.29
30	3,781,089	3,329,839	82.2	72.4	0.2	10.0	0.02	1.29
20	3,784,235	3,329,839	82.3	72.4	0.1	10.0	0.01	1.29
10	3,789,168	3,329,839	82.4	72.4	0.0	10.0	0.00	1.29
0	3,789,168	3,329,839	82.4	72.4	0.0	10.0	0.00	1.29

10.3.5 Expenditures on wildlife-preserving management practices

Table 71: Investments in promoting environmentally friendly practices in Ontario under different federal and provincial cost share programs

Category Code	BMP Category	Projects paid	Federal Cost Share[1]	Provincial Cost Share[2]	Farmer Cost Share[3]	Federal $ paid[4]	Provincial $ paid[5]	Farmer $ paid[6]	Total $ paid	Farmer Cost		
										($/year/project)	($/ha/project)	**% of Total Cost[7]**
21	Enhancing wildlife habitat and biodiversity	54	50%	50%	0%	145,818	145,818	0	291,636	0	0.00	**0.00**
22	Species at risk	2	50%	40%	10%	1,133	906	227	2,266	113	0.47	**0.05**
23	Preventing wildlife damage	61	30%	60%	10%	190,472	380,943	63,491	634,905	1,041	4.36	**0.50**
28	Biodiversity enhancement planning	3	50%	50%	0%	2,025	2,025	0	4,050	0	0.00	**0.00**
	Total	120				339,447	529,692	63,717	932,856	531	2.22	**0.26**

Notes:

1. Federal Cost Share under Canada-Ontario Farm Stewardship Program, Greencover Canada and Canada-Ontario Water Supply Expansion Program
2. Provincial Share under Wetland Farm Stewardship Incentive Program, Oak Ridges Moraine Environmental Enhancement Program and Greenbelt Farm Stewardship Program
3. Farmer cost share = 100% - (federal cost share+ provincial cost share)
4. Reported federal funds paid
5. Provincial funds paid estimated using the available cost share figures
6. Farmer funds paid estimated using the available cost share figures
7. Assuming an average total cost for corn-wheat-soybean rotation of $863 (2007 Ontario crop budgets)

Sources:
Food Safety Network (http://archives.foodsafetynetwork.ca/animalnet/2006/10-2006/animalnet_oct_31-2.htm#story4)
Ontario Soild and Crop Improvement Association (http://ontariosoilcrop.org/User/Docs/Programs/BMP%20Jan06.pdf)
Conservation Ontario (http://conservation-ontario.on.ca/news/files/ORMEEP_brochure_final.pdf)

10.3.6 Nature Conservation, Biodiversity and Landscape

Reducing previously mentioned emissions by using good management practices usually leads to improvement in biodiversity.

Most relevant practices

- conservation of wetlands;
- promoting crop rotations to reduce pesticide use;
- conservation tillage;
- avoiding the fragmentation of habitat;
- assessment of severity of pest species competition prior to pesticide use;
- fertilizer application linked to nutrient budgets to avoid over-application.

(Weersink and To, 2001)

10.3.7 Wildlife Habitat and Wetlands Model

Delaporte (2007) in his Wildlife Habitat and Wetland Model (WHWL) incorporates a wildlife habitat provision constraint and agricultural returns from a wetland drainage or preservation decision. It incorporates fewer parameters than the more complex models, also used in the study but is useful because it focuses on wildlife habitat provision cost, isolating it from the other factors. Table 72 illustrates some of the results produced by the model. It is evident that, there are quite high foregone agricultural returns per hectare of a preserved wetland, the cost of wildlife habitat preservation is quite low when distributed over the whole agricultural land area. Namely, achieving maximum wildlife score, would involve $14/ha reduction in net revenues per every hectare of agricultural land. This would be equivalent to equivalent to 1.9%) of the total cost of production on owned land (land rent is zero) for a typical corn-wheat-soybean rotation ($774/ha) ***(see crop budgets).***

Table 72: Summary of foregone agricultural returns resulting from wildlife habitat preservation in the Eramosa watershed

Wildlife Habitat Model Constraint	%) of Maximum Wildlife Habitat Score	Actual Wildlife Habitat Score Achieved	Agricultural Returns	Forgone Agricultural Returns	Wetlands Drained	Wetlands Preserved	Wetland Acres Drained	Wetland Acres Preserved	Average Cost of Wetland Preservation ($/Acre)	Average Cost of Wetland Preservation ($/ha of preserved wetland)	Average Cost of Wetland Preservation ($/ha of agricultural land area)	Average Cost of Wetland Preservation (%) of total cost of production)
0	0	1294	399083	0	51	5	3543.4	408.8	0	0	0.0	0.0
1210.7	10	1294	399083	0	51	5	3543.4	408.8	0	0	0.0	0.0
2421.4	20	2809	389515	9568	50	6	3120.9	831.3	11.5	28.4	0.3	0.0
3632.1	30	3645	382281	16802	43	13	2816.7	1135.5	14.8	36.6	0.6	0.1
4842.8	40	4843	353917	45166	41	15	2516.9	1435.3	31.5	77.8	1.6	0.2
6053.5	50	6058	322814	76269	36	20	2143.4	1808.8	42.2	104.2	2.8	0.4
7264.2	60	7268	284257	114826	30	26	1699.3	2252.9	51.0	125.9	4.2	0.5
8474.9	70	8482	238958	160125	26	30	1355.3	2596.9	61.7	152.4	5.8	0.7
9685.6	80	9689	173005	226078	18	38	907.1	3045.1	74.2	183.5	8.2	1.1
10896.3	90	10897	96026	303057	13	43	487	3465.2	87.5	216.1	11.0	1.4
12107	100	12107	0	399083	0	56	0	3952.2	101.0	249.5	14.5	1.9

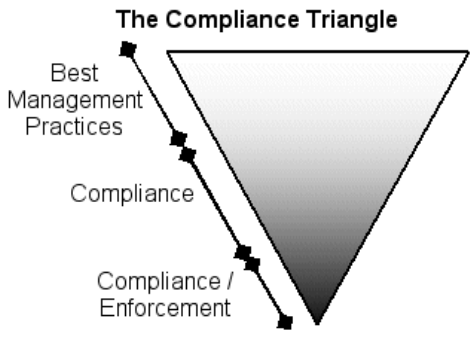
11 Summary and Implications

No effort is done to summarize all the information provided in the previous chapters. Here the focus is to derive two main conclusions relevant for the analysis of impacts of standards on competitiveness in the cereals sector (as taken up in the main Deliverable D13 to which this document is an annex). As such this section characterizes the Canadian approach as one the is distinct form that in the EU (and detailed documented before) and its summarize the best estimates of the percentage costs increase due to standards equivalent to the EU's GAECs for the Canadian cereals farms. This latter information was used in the set-up of the EU external competitiveness analysis with the GTAP trade model.

11.1.1 Canada follows alternative regulatory strategy

The compliance strategy in Canada differs from that in the EU. A general illustration of the provincial compliance strategy in Canada is given in Figure 15. It are the provinces who are the lead jurisdiction on environmental issues such as nutrient management, water resources protection, wildlife and habitat protection, land use and planning, soil quality, agricultural waste product management. Agriculture, including issues of plant and animal health, as well as food safety issues is a shared federal/provincial jurisdiction. The shading on the triangle (see Figure) represents how well operations are managing environment issues on-farm. The light area represents operations that are in compliance but which may benefit from additional best management practices. The grey section represents operations with relatively minor violations. The compliance program is designed to move the operations from the grey area into the lighter area (or into compliance) using a problem-solving approach. Using this approach, Agricultural Environmental Officers (AEOs) will work with farmers to achieve compliance with the legislation. The dark area represents those very few operations that refuse to comply with the law. For these operations enforcement action is an option; however, the intent of the compliance program is still to help operations move into the lighter area through a problem-solving approach.

Figure 15: The Canadian compliance triangle-model



11.1.2 Magnitude of Costs

After examining relevant literature, it became evident that cost estimates can vary depending on the type or regulation (i.e. cost-share programs vs. mandatory regulations vs. voluntary standards) region, crops involved, pollution mitigation practices involved. However, some general inferences can be made. Firstly, there are cropping practices that are already profitable and this is supported by evidence on the field (i.e. increasing share of no-till and conservation tillage). However, there are possible impediments for adoption, such as learning costs or high fixed switching costs. In this case, extension services and one-time financial support to overcome the fixed costs of switching to new practices may be beneficial.
Secondly, there are practices associated with minimal costs (i.e. reduction in nitrogen use) but there may be other impediments to implementation as well. For example there is evidence in Ontario that farmers are reluctant to reduce their nitrogen rates despite the extension service encouragement. This indicates that there may be other costs involved (i.e. yield risk, crop amenity value, effect of other inputs, opportunity cost of spring or side-dress fertilization). In this case, in addition to a nitrogen use regulations, programs such as yield insurance and education may be beneficial
Thirdly the practices that involve the highest costs are those where certain investments have to be made or where land is taken out of production. Examples are wildlife preservation, buffer strips, and variable rate fertilization. The extent of adoption of these practices is the lowest and, depending on the level of government support, policies promoting the use of such practices can have high impact on farm costs. Most of the described practices[33].

11.1.3 Best estimates of percentage costs increases associated with BMPs in Canada

Summarizing, the main conclusions from the comparative EU-Canada analysis are that, by international standards, Canada has a low-intensity agriculture. Nevertheless, most EU environmental regulations that apply to agriculture have a counterpart in Canada. At one or more of the federal, provincial or municipal levels compliance is promoted through a range of measures. Compliance costs are quite low for cereals. Table 5.1 summarizes our best-estimates. These estimates form an input into the EU's external competitiveness analysis as is further described in D13.

[33] It is important to note that high proportion of Canadian cereal farms raises livestock. Thus, the Nutrient Management Act stipulations apply to farms with more than 300 livestock units per farm and farms building new livestock facilities. This has important implications for compliance costs.

Table 73: Compliance costs for GAEC-equivalent measures in Canadian cereals production

EU Standard	**Comparable standard (or recommended practice) in Canada**	**Compliance cost (% of total cost of production)**		
		Low end	Most likely	High end
Conservation of Natural Habitats, wild flora and fauna	Canada Wildlife Act; Species at Risk Act	0	0.3	1.9
GAECs	**Best Management Practices**			
	Variable rate fertilization	0	0	1.1
	Buffer strips	0.2	0.3	0.9
	Other BMP's	0	1.5	3.1
Total Cost		**0.2**	**2.1**	**7.1**

Table 74: Summary on literature on environmental abatement costs

Year	Author(s)	Title	Publication Type	Environmental Attribute(s)	Region/Province	Relevant Environmental Legislation/policies/programs	Policy Strategy for Achieving Compliance	Changes in Farm Practices Involved	Crops Involved	General Findings	Environmental Indicator Measured/estimated	Environmental Indicator Change Level(s)/Targets	Cost	Estimation Method
1995	Cesareo Giraldez and Glenn Fox	An Economic Analysis of Groundwater Contamination from Agricultural Nitrate Emissions in Southern Ontario	Paper (based on his M.Sc. thesis	Groundwater quality	Southwestern Ontario	Water Quality Act; (other?) Health Canada maximum contaminant limit (MCL)	Limit on nitrogen use; nitrogen tax; use bottled water	Reduction in nitrogen use	corn	Reduction of nitrogen application appears to be a less costly means of remediation relative to bottled water unless a blending approach is used. An ad ***vulorem tax*** rate of 55 %) would have to be applied to nitrogen to induce farmers to reduce nitrogen use to the level required to satisfy the drinking water standard.	Nitrate concentration in groundwater estimated from nitrogen application rate	Decrease to below 10 mg/l	$1.8 l/ha for a ceiling on Nitrogen use; $49.7/ha for a nitrogen tax;	
1999	ANASTASIA M. LINTNER and ALFONS WEERSINK	Endogenous Transport Coefficients: Implications for Improving Water Quality from Multi-Contaminants in an Agricultural Watershed	Paper	water quality (nitrate leaching and phosphorous loss)	Ontario	Water Quality Act; (other?) Health Canada maximum contaminant limit (MCL)	i) a mandatory switch in farming practices, ii) a ceiling on nitrogen fertilizer applications, iii) a uniform nitrogen fertilizer tax, and iv) an ambient tax/subsidy scheme.	no-till; reduced fertilizer use; crop rotation	corn, wheat, soybeans	only phosphorous concentration relatively high; tax/subsidy preferred instrument;	phosphates in surface water	20%) reduction in phosphate concentrations;	MC=$1,415 per mg/L for the whole watershed; $94.39 per mg/L for one farm; reduction in farm profits 1.5%)-3.3%)	simulation; crop budgeting
2000	Jean-Christophe Dissart, Laurie Baker and Paul J. Thomassin	The Economics of Erosion and Sustainable Practices: The Case of the Saint-Esprit Watershed	paper	Soil erosion, water quality	Quebec		subsidy; regulation	crop selection (more hay); reduced tillage	corn, soybean, barley;	farms with higher net incomes would be better off if the erosion target value were set at the watershed level, while farms with lower net incomes would be worse off.	sediment loading	0-94%) reduction;	0-$2010/ha; (31%) reduction: $9-$123/ha	simulation and farm budgeting
2000	Emmanuel K. Yiridoe, Alfons Weersink, David C. Hooker, Tony J. Vyn4 and Clarence Swanton5	Income Risk Analysis of Alternative Tillage Systems for Corn and Soybean Production on Clay Soils	paper	soil erosion; soil degradation	Southwestern Ontario	Land Stewardship Program		reduced tillage	corn; soybeans					
2006	Andreas Meyer-Aurich, Alfons Weersink, Ken Janovicek, Bill Deen	Cost efficient Tillage and Rotation options for Mitigating GHG Emissions from Agriculture in Eastern Canada	Paper	air quality (GHG emission)	Ontario	Kyoto Accord	not specified	reduced tillage; crop rotation; input use	corn, wheat, soybeans, alfalfa, barley	reduced tillage and no till impose a cost not only by reducing farm profits but also by increasing risk.	GHG emissions in CO2 equivalent	about 1 Mg/ha reduction	AC=$200-$1000 Per Mg of CO2 equivalent	
1998	Alfons Weersink, Charry Dutka and Michael Goss	Crop Price and Risk Effects on Farm Abatement Costs	Paper	Groundwater Quality	Southwestern Ontario	Water Quality Act; (other?)	performance standards; design standards; performance tax; design tax	crop selection; input use	corn, soybeans, wheat	Standards much less costly than taxes; pricing strategies change costs but not dramatically; risk attitudes important	Nitrate level in groundwater	<10 ppm	$9-$(113/ha depending on policy instrument, pricing scenario, and risk aversion level	simulation
1995	Glenn Fox, Gloria Umali and Trevor	An Economic Analysis of Targeting Soil Conservation Measures with Respect to	Paper	Water quality	Southwestern Ontario	Water Quality Act; Health Canada	Nitrogen application limit; tax on nitrogen	Reduced nitrogen fertilizer use	corn, wheat, soybeans	Nitrogen application limit much less costly than tax on nitrogen. In this particular case cost is low but it can be	Nitrogen level in groundwater	<10 ppm	$1.8/ ha if limiting N use; 49.7 if imposing a nitrogen tax	CREAMS simulation model

Year	Author(s)	Title	Publication Type	Environmental Attribute(s)	Region/Province	Relevant Environmental Legislation/policies/programs	Policy Strategy for Achieving Compliance	Changes in Farm Practices Involved	Crops Involved	General Findings	Environmental Indicator Measured/estimated	Environmental Indicator Change Level(s)/Targets	Cost	Estimation Method
	Dickinson	Off-site Water Quality				maximum contaminant limit (MCL)	fertilizer			much higher if greater reductions in N use are needed.				
1998	Emmanuel K. Yiridoe and Alfons Weersink	Marginal Abatement Costs of Reducing Groundwater-N Pollution with Intensive and Extensive Farm Management Choices	Paper	Water Quality	Ontario	Water Quality Act; Health Canada maximum contaminant limit (MCL)	Leaching limits; cost sharing	crop choice, crop rotation, and tillage treatment,	corn; wheat; soybeans	choice of a cost-effective farming system for mitigating nitrate leaching is more critical under more stringent standards than at higher pollution levels.	Amount of nitrogen emitted (leached) per ha of land (kg of N/ha)	<10 ppm (equivalent to 15.2 kg N/ha leaching)	MC=$260-$416/ha for corn; MC=$25-$52/ha	CENTURY biophysical simulation model
1999	D. PETER STONEHOUS	ECONOMIC EVALUATION OF ON-FARM CONSERVATION PRACTICES IN THE GREAT LAKES REGION OF NORTH AMERICA	Paper	water quality; soil erosion	Southwestern Ontario			introduction of pasture/hay; supplemental reduced tillage or no-till; grassed buffer strips	corn; wheat; soybeans	there are benefits in the form of reduced sediment and phosphorous loading but this not necessarily mean better water quality (depends on the purpose of water use as well as other polluters present).	phosphorous and sediment discharge into surface water	0 to 99%) reduction	max farm cost: $285/ha; max farm benefit $175/ha; on average, both economic and environmental benefits ($3.8/ha)	simulation
1999	Brian S. Freeze and T. Peters	A Note on the Profitability of Wheat-ethanol-feedlot Production in Alberta	Paper	air quality	Alberta	Kyoto Accord	with or without subsidies		wheat	adoption questionable without subsidies	CO2; N2O levels in air	10%) reduction in CO2; 5%) red. In N2O (assuming 10%) blend can reduce GHG emissions by 4%))	$168/ha - $375/ha loss compared to selling wheat to the wheat board; 106 L/ha; $16.8-$37.5 per L of ethanol. 1060 L of 10 %) blend per ha; $0.16-$0.35/L of 10%) blend	crop budgeting; multi-year yield data
2005	Elwin G. Smith and B. Mani Upadhyay	Greenhouse Gas Mitigation on Diversified Farms	Paper	Air quality	Prairies	Kyoto Accord	not specified	crop rotation; crop mix; minimum tillage; reduced fertilizer application	wheat barley oats, canola, mustard, flax, lentil, field pea, hay, and summer fallow	Emissions could be reduced by altering the livestock system, however the costs are high, so most of the adjustment to reduced GHGs is on the crop sector.	CO2, N2O and methane emission expressed in CO2 equivalent	10%) reduction with livestock numbers fixed (most of the reductions comes from changes in cropping practices)	MC=$273/t CO2-eq. Cost much lower if the initial soil carbon level is low (less than $30/ha)	simulation
1997	Ahmad Gheidi	Carbon Sequestration in Agricultural Solis: An Integrated Modeling Approach	Ph.D. Thesis	air quality; water quality (Soil Erosion, GHG emission)	Saskatchewan	Kyoto Accord	voluntary compliance; incentive programs	input use	canola, wheat	Abatement cost too high compared to the current (1997) estimates of social benefits (willingness to pay); climate change assumption increases cost	Level of organic matter	12.5%) increase	$43.77/ha	simulation
2005	Wanhong Yang, Chaodong Sheng and Paul Voroney	Spatial Targeting of Conservation Tillage to Improve Water Quality and Carbon Retention Benefits	Paper	GHG emission; soil erosion	Ontario	Kyoto Accord		Conservation Tillage	corn, soybeans, winter wheat	Sediment abatement and carbon retention can be achieved at the same time; extent of both varies significantly locally; setting sediment targets more cost-effective way of achieving both	Soil Carbon; sediment in surface water	decrease carbon emissions by 23 -40%); decrease in sediment loading by 20 - 35%)	Marginal Cost $37-$209/ton of C Marginal cost $1.7 -$7.7/ton of sediment	Simulation (GIS-based integration of SWAT model, farm model, and Century model)
2005	JAMES MANLEY, G. CORNELIS VAN KOOTEN,	CREATING CARBON OFFSETS IN AGRICULTURE THROUGH NO-TILL CULTIVATION: A META-	Paper	GHG emission	North America, and outside N.A.	Kyoto Accord	Subsidies, voluntary compliance	Conservation Tillage	wheat, corn, other	Relatively high costs per ton of stored carbon; other industries may be more cost-effective in mitigating GHG emissions; soil erosion benefits may be a better incentive	Level of soil organic matter		South Wheat $10.06 - $12.61 Other crop $1.94 - $1.96 Prairies Wheat $376.08 - ∞	meta-analysis

Year	Author(s)	Title	Publication Type	Environmental Attribute(s)	Region/Province	Relevant Environmental Legislation/policies/programs	Policy Strategy for Achieving Compliance	Changes in Farm Practices Involved	Crops Involved	General Findings	Environmental Indicator Measured/estimated	Environmental Indicator Change Level(s)/Targets	Cost	Estimation Method
	KLAUS MOELTNER, and DALE W. JOHNSON4	ANALYSIS OF COSTS AND CARBON BENEFITS											Other crop $147.34 - $207.72 Corn Belt Wheat $142.01 - $186.22 Other crop $84.03 - $86.36 ($US/ton C at 25 and 50 cm depth…***divide*** by 3.66 to get $/CO2 equivalent)	
2005	Antony K. Samarawickrema and Ken W. Belcher	Net Greenhouse Gas Emissions and the Economics of Annual Crop Management Systems	Paper		Saskatchewan	Kyoto Accord	subsidies	reduced tillage; no-till	spring wheat' canola, barley, peas, fallow				AC=$18-$88/tCO2 Equivalent	simulation using STELLA software
1998	C.H. Sijtsmaa, A.J. Campbella, N.B. McLaughlinb, M.R. Cartera,	Comparative tillage costs for crop rotations utilizing minimum tillage on a farm scale												
2001	Cecil N. Nagy	An Economic and Agronomic Analysis of Reduced Tillage												
1995	D. Peter Stonehouse,I S. F. Weise, T. Sheardown, R. S. Gill and C. J. Swanton	A Case Study Approach to Comparing Weed Management Strategies under Alternative Farming Systems in Ontario												
1999	Gary Vandergaast	Opportunities for Reducing Greenhouse Gas Emissions by Using Ethanol-Based Fuels: An Eastern Ontario (Canada) Case Study of the Potential For Grain Corn Production												
2005	Murray Fulton, Monika Cule, Alfons Weersink	Greenhouse Gas Policy and Canadian Agriculture												
2002	Nicole Lucille McLaughlin	Field Evaluation of Management Systems for Reduction of N2O Emissions from a Corn-Soybean-Wheat Rotation	M.Sc. Thesis											
2001	Ravinderpal S. Gill, Cecil N. Nagy, Robert P. Zentner, Andre Hucq, Robert J. MacGregor, Martin H. Entz, John C. Giraldez	OPPORTUNITIES FOR REDUCED NON-RENEWABLE ENERGY USE IN CANADIAN PRAIRIE AGRICULTURAL PRODUCTION SYSTEMS												
1997	W. van Vuuren,	The Social Returns of												

Year	Author(s)	Title	Publication Type	Environmental Attribute(s)	Region/Province	Relevant Environmental Legislation/policies/programs	Policy Strategy for Achieving Compliance	Changes in Farm Practices Involved	Crops Involved	General Findings	Environmental Indicator Measured/estimated	Environmental Indicator Change Level(s)/Targets	Cost	Estimation Method
	J. C. Giraldez and D. P. Stonehouse	Agricultural Practices for Promoting Water Quality Improvement												
2004	Wanhong Yang and Alfons Weersink	Cost-effective Targeting of Riparian Buffers												
2005	Wanhong Yang, Chaodong Sheng and Paul Voroney	Spatial Targeting of Conservation Tillage to Improve Water Quality and Carbon Retention Benefits												
2005	Randall Wigle	Canada, Public Economics and Climate Change												
1999	Ken McEwan and Bill Deen	Pesticide Price Differentials Between Canada and The U.S.												

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Part III: New Member States and Cross-Compliance: The Case of Cereals and Beef in Poland

12 Introduction

Part III presents an in-depth analysis of the Polish case, with special reference to its cereals and beef sector. The analysis carried out for Poland has been focused on issues of implementation and impacts taking into account the special position of new member states. In the new member states as part of cross-compliance farmers eligible for direct payments have to satisfy the GAECs. From 2009 and onward also the SMRs will be part of the cross-compliance package and non-compliance with SMRs can lead to a reduction in direct payments. It provides a discussion of the challenges the implementation of CC imposes to the policy maker as well as the required institutional capacity that has to be built up. Attention is paid to the various institutions involved, the farm advisory service, monitoring and control and the gradually phased in implementation. More specifically the implementation of the cross compliance package to the cereals and beef sectors is discussed, including regulation specific issues. In the concluding section an effort is made to draw some lessons for new member states and formulate some main conclusions.

Parts and results of the research reported in this Annex have been integrated in various places into the analysis done in the main report (see references in the main text).

12.1 New member states and cross-compliance

On 1 May 2004, ten new EU member states started to implement CAP measures, including direct payments under the First Pillar of the CAP. Most of them (excluding Slovenia and Malta) chose to receive the payments under the Single Area Payment Scheme. There were several reasons behind that decision, one of which was the lower level of payments that farmers from the new member states received when compared to the payments for farmers of the EU 15[34].

[34] In order to compensate for lower payment rates, the European Commission agreed that the governments of the new member states increase the amount of payments from their own financial resources (until 2006 a part of funds from the budget of the Second Pillar can be allocated for this purpose). Direct payments rates should become equal before the end of 2013.

When choosing payments based on the Single Area Payment Scheme, governments of the new member states became responsible for ensuring that farmers obtaining direct payments maintain their agricultural land in good agricultural and environmental condition (GEAC), especially if it is not used for production purposes. This requirement differs substantially from the standards that have to be fulfilled by farmers from the EU 15 as well as from Slovenia and Malta, which not only have to satisfy the GAEC requirement, but are also obliged to meet the other cross-compliance (CC) requirements (statutory and management requirements, SMRs).

By the end of 2009, eight new member states will have to change from the Single Area Payment Scheme to the Single Payment Scheme. Therefore, they should already work on specifying implementation rules for CC and SMR. At this moment, there is only limited information available on how respective new member states are trying to manage this task. This does not mean, however, that farmers in the new member states do not have to comply with standards introduced by legislation related to cross – compliance. In most countries they have to implement them, but the scope of responsibility differs. If farmers in the new member states (excluding Slovenia and Malta) do not meet their obligations in this respect, they are liable in administrative, civil and criminal terms, but it does not have any impact on the possibility of obtaining direct payments.

This annex analyses the challenges cross compliance imposes to the New Member States, by exploring the case of Poland. It is organized as follows. The remainder of this section provides some more basic information on Polish agriculture. Section 13 provides a discussion of the challenges the implementation of CC imposes to the policy maker as well as the required institutional capacity that has to be built up. Attention is paid to the various institutions involved, the farm advisory service, monitoring and control and the gradually phased in implementation. The following two sections (Sections 14.1 and 14.2) focus on the implications of the implementation of cross-compliance for the cereals and the beef sector respectively. Particular challenges as well as potential impacts on farm profitability and competitiveness are discussed A final section (Section 16) closes the paper. In the concluding section an effort is made to draw some lessons for new member states and formulate some main conclusions.

12.2 Characterization of Polish agriculture

Poland is a country with average agricultural land resources. In 2003, the Utilised Agricultural Area (UAA) was 16.2 million ha, i.e. it accounted for 51.7% of the total Poland's area. The area used for feeding purposes as expressed in UAA per capita is high as compared to the EU average and equals 0.42 ha. The large differentiation of farm size – from one hectare to several thousand hectares – constitutes one of the characteristic features of Polish agriculture. Small farms are characteristic for the private sector, accounting for 94.8%

of the total UAA. The public sector manages 5.2% of the agricultural land. The land belongs mainly to the State Treasury farms set up on former state-owned farms. The problem of agricultural holding fragmentation occurs solely in the sector of private (family) farms. Enlargement of the existing farms is a permanent process that began at the early 1990s. Despite this, due to the low profitability of agricultural production and capital shortages, the pace of agrarian structure change is slow. It has to be noted, however, that during the last years, the share of farms with more than 15 ha of UAA has significantly increased.

Polish agriculture is characterised by a fragmented structure and technical backwardness. 24.9% of agricultural farms (but only 14% of UAA) cover a consolidated piece of land, and 5.9% (15% of UAA) comprise more than 10 pieces of land (MARD, 2006). The high fragmentation of agricultural land and the low level of intensification in agricultural production constitute the most important factors that are decisive for the large biological diversity of the Polish nature.
According to the General Population and Housing Census and the Agricultural Census, conducted in 2002, 10 474 500 people, i.e. 27.4% of Poland's population, lived in households connected with a farm (area of more than 10 ares) user. 80%, or 8 504 900, people were inhabitants of rural areas. This implies that 58.2% of the total rural population was connected with farming through a common household (MARD 2003)[35].

Land productivity in Poland is lower than in the EU-15. It results from worse soil and climatic conditions as well as extensive production. Yields in Poland are approximately twice as low as the average yields in the EU.

According to the 2002 General Agricultural Census data, 935 200 agricultural holdings were involved in cattle rearing and breeding, i.e. 31.9% of the holdings of an acreage from 0.10 ha, 875 400 in cow rearing (29.8%) and 760 600 agricultural holdings were engaged in pig raising and breeding (25.9%)[36]. Despite an increase in the concentration of livestock production, it remains low and is conducive to environmental protection. As for slaughter animals, pigs dominate and the importance of poultry meat production is growing.

35 MARD, 2004: Agriculture and food economy in Poland – figures. Ministry of Agriculture and Rural Development. Warsaw

36 MARD, 2004 Ibidem.

13 Changes in agriculture policy induced by EU accession

13.1 GAEC implementation

Although the harmonization of the Polish legislation with the European law began at the end of the 1990s, most of the activities were conducted only in the first years of the 21st century. Nevertheless, the level of adjustment is high, both in the area of environmental protection as well as agricultural activities. The current level of holdings' adjustment to the requirements of the directives which define the SMRs and the selected problems connected to it are presented in the table below.

As was mentioned before, currently Polish farmers (who received direct payments) are obliged to only satisfy the GEAC requirements. The Act of 18 December 2003 on direct payments for agricultural land (DU 6/2004.40) constitutes the basis for introduction of provisions on the requirements regarding the maintenance of agricultural land in a good environmental condition. Detailed criteria on the minimum requirements for the maintenance of agricultural land in a good agricultural condition are provided in the Regulation of the Minister of Agriculture and Rural Development of 7 April 2004 (DU 65/2004.60). These requirements became legally binding when Poland joined the European Union. According to these provisions, the maintenance of agricultural land in a good agricultural condition that respects environmental protection requirements involves the measurements as spelled out in Table 75.

Table 75: Maintenance of agricultural land in a good condition

Maintenance of agricultural land in a good condition	– cultivating the land with plants or laying it idle – for agricultural land; – cutting the plant cover and removing it at least once a year before 31 July – for meadows; – cutting plant cover and removing it at least once a year before 30 September – for molinia meadows under agri-environmental programs; – animal grazing during the vegetation period for grass or cutting the plant cover and removing it at least once a year before 31 July – for pastures.
Soil erosion	Arable land on slopes with an angle over 20° should not be: – used for cultivation of plants that require maintenance of ridges along the slope; – maintained as bare fallow. If such lands are used for cultivation of perennial plants: – plant cover or mulching between rows should be maintained, or cultivation should be performed with a terraced method.
Fallow	Arable land should not lay fallow for longer than five years. Arable land is considered as fallow if at least once a year, prior to 15 July: – it is cut, – it undergoes other cultivation measures that prevent weeds from occurring or spreading
Meadows and pastures	It is allowed for meadows and pastures to be used interchangeably. Meadows, pastures and stubble fields should not be burnt.
Plant cover	Agricultural land should not be grown with trees and shrubs, except for trees and shrubs that: – should not be cut down pursuant to nature conservation provisions; – are important for water and soil protection; – do not have impact on plant production conducted within the area; – occur on plantations of roses (Rosa multiphlora) or willow (Salix sp.)

Source: Own assessment based on the Act of 18 December 2003

13.2 Institutional challenges

The discussion on further CC implementation in Poland is conducted only to a limited extent and by a limited number of partners. Environmental protection public institutions or environmental non-governmental organizations are practically excluded from the discussion, whilst the contribution of farmers is small. Comments on the necessity to adjust to the new requirements are most frequently voiced by scientists and experts, agricultural advisory units and organizations representing farmers and agricultural producers. Most frequent opinions refer to the difficulties that Polish farmers will have to face due to the SMR implementation. The discussion lacks a wider exchange of opinions on how to implement these requirements in Poland. This results mainly from a rather passive approach of the Ministry of Agriculture

and Rural Development, which is not interested in an intensive implementation of the new measure.

There are several public institutions responsible for implementation of CAP and its instruments in Poland. Most probably, also the following institutions will be responsible for SMR implementation:

- Ministry of Agriculture and Rural Development
- Agency for Restructuring and Modernization of Agriculture
- Agricultural Market Agency
- National Veterinary Institute
- Main Veterinary Inspectorate
- Institute of Fertilization and Soil Science in Pulawy
- Main Inspectorate of Plant Protection and Seed
- Center of Agriculture Advisory Services

The list of institutions involved in the implementation of the CC will certainly be longer and encompass among others, institutions connected with environmental protection, including:

- Ministry of Environment,
- Voivodeship Inspectorates of Environment Protection.

Currently the co-operation between these institutions is very weak. There are yet no common working groups dealing with cross compliance requirements and implementation in Poland. It is expected that there will arise problems on how to split responsibilities and competences between institutions dealing with agricultural problems and environmental ones. Previous experience shows that co-operation between agri - and environmental institutions could be one of the most important barriers for effective implementation of the new requirements.

13.3 Farm Advisory Service

By the end of 2009, Poland will have to change from the Single Area Payment Scheme to the Single Payment Scheme. Among the preparatory activities for CC introduction the most important one is the transposition into national law of the 14 directives that serve as a basis for the SMR. This then constitutes a legal framework for the CC introduction in Poland. Moreover, the reform of the agricultural advisory service is also important. After the reform, there will be both state and private agricultural advisory services. The state system will comprise of:

- The Agricultural Advisory Centre in Brwinów, a state institution under the Minister of Agriculture and Rural Development with branches in Kraków, Poznań and Radom and
- 16 voivodship agricultural advisory centres under a relevant voivod.

The public agricultural advisory service currently (2007) employs over 5600 people, out of which around 3950 specialists and advisers that provide services to around 1850 thousand holdings, which gives an average of 470 farmers for one adviser. Both farmers and advisers believe that the system is not well-suited to provide services in the CC requirements implementation, and due to the large number of farmers per adviser, only a limited number of producers has access to advisory services of proper quality. At the same time it is assumed that the basic form of advisory services within the CC will be individual advisory, whilst the remaining methods, like publications, Internet or training, will play a supplementary role. The possibility to charge farmers for advisory services[37] (introduced by the new act on agricultural advisory) raises further concerns. Although the Rural Development Programme 2007 – 2013 provides for subsidies for advisory services under the FAS (up to Euro 1500 per famer and not more than 80% of qualified costs), it may be expected that a large share of small holdings will not make use of the advisory assistance[38]. This may impediment the CC requirements implementation in such holdings.

The Task Force for Basic Requirements in Cross Compliance Management is to prepare a detailed scope of the requirements to be met by Polish farmers within the SMR. The Task Force is an advisory unit by the Minister of Agriculture and Rural Development and it has been authorized to prepare guidelines for the CC implementation in Poland. A number of expert studies have been prepared within the activities of the Task Force, which have not served, however, as a basis for any wide public discussion. Despite training and information activities conducted by some of the agricultural advisory centres, therefore the preparation of Polish farmers and administration to fulfill the commitments resulting from the CC system has still to be judged as insufficient[39].

13.4 Monitoring and control

Institutional problems and the high or significant (public as well as private) cost of SMR implementation constituted the main reasons brought up by Poland in favor of postponing of the obligation to implement all of the CC requirements.

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37 Until 2005 the services provided for farmers by the state agricultural advisory units were free of charge.

38 This is even more probable given the fact that these costs will be refunded, which for the majority of small holdings with low income and without free financial resources constitutes a significant barrier in making use of the advisory services.

39 This is why Poland and other new member states insisted that the transition period for fulfilling all of the CC requirements was prolonged until the end of 2012, i.e. until farmers from the new member states obtain the same direct payments as farmers from the EU 15. On 11 June 2007, in Luxembourg, Agriculture Ministers gave their preliminary consent, but the details for the transition period will be agreed on in the second half of 2007 (Polish Press Agency. Information from Luxembourg, 11.06.2007 5.34 p.m.)

In Poland, there are approximately 1.8 million holdings, circa 1.5 of these apply for direct payments, which, given a 1% sampling intensity, means that the inspection shall be conducted in 15 thousand farms. This means that although Poland's participation in the direct payments shall amount to circa 2.5 - 7% in the period between 2005-2012 (Regulation (EC) 583/2004). Poland's share in the total EU-27 inspection costs shall amount to 15 - 20%. Though this may not directly influence the holdings competitiveness, it will indirectly influence the competitiveness of the agrarian sector as a whole. Additionally, the large number of holdings, apart from the high cost of the inspection procedures, will generate a high cost of the farmer-oriented information campaign; especially the effort to advance the information concerning the CC requirements into all the farmers entitled to receive the direct payments.

13.5 Phased-in implementation

Institutional problems and the significant costs of SMR implementation constituted the main reasons brought up by Poland in favor of postponing or a more gradual phase-in of the obligation to implement all of the CC requirements.

Another reason relates to the lengthy transformation process that the agricultural sector in Poland is undergoing. During last 17 years the situation in the sector changed several times, with new solutions, procedures and instruments introduced. Due to the sector's situation, the underdeveloped character of the Polish countryside, the small size of the holdings as well as the large significance of agriculture in Poland (not only from the economic point of view but also from the social, cultural and environmental perspectives) the process of adjusting to the Community requirements was very demanding and some of the tasks have not been completed yet. This limits the level of resources that agricultural administration can earmark for preparation to implementation of a new measure. Despite the efforts taken to adjust the Polish holdings to the requirements of environmental protection and wildlife welfare, there are still urgent issues to be dealt with. This means that in a short time the Polish holdings will need to make investments in order to adjust. This may prove to be difficult due to the high costs and the lack of personal capital and loan capacity in the case of the majority of the farmers. Although the situation is being improved by the EU funds intended for the development of the rural regions the use of this source is likely to be not be sufficient.

There also exist additional, political reasons for the low involvement of public institutions in the preparation of CC implementation in Poland. Prior to the EU integration, farmers had constituted one of the social groups with the most negative attitude towards the accession. This resulted from the deep crisis in the Polish agriculture dating back to 1989 and farmers' concerns that after the EU accession their situation would aggravate. When Poland became an EU member and different CAP measures started to operate – first and foremost direct payments but also other measures of the I and II pillar – farmers' attitude towards the EU

changed significantly – most of them started to support the country's membership in the Community. Highlighting the necessity to implement costly investments at the holding level could lower this support and drastically decrease farmers' backing for the current governmental coalition. Therefore, the authorities have been postponing the preparation process for CC implementation and have not been informing farmers on the future requirements, hoping that this could be passed on to the next governmental coalition.

14 Applying CC to the Cereal and Beef Sectors

14.1 The cereals sector

The total area sown to crops in 2004 was 11,3 million ha. The major crop in Poland is cereals, whose share within the crop structure has been constantly increasing. Despite of high share in the crop structure of cereals, Poland has been their net importer of cereals in the majority of years. Imports do not only include rice and high-gluten varieties of wheat, for the cultivation of which there are no appropriate agro – climatic conditions in Poland, but also fodder grains (especially maize) and malting barley. There is no clear tendency in the volume of cereals exported and imported by Poland. It appears that after the EU accession the volume exported has increased. At the moment, wheat and oats occupy the largest acreage; the acreage of triticale has been increasing. Due to the canceling of the intervention buying-in in rye after the EU accession, the area cultivated with this cereal has decreased significantly[40]. Noticeable changes have occurred also in maize production, as between 1995 and 2006 the area cultivated with this crop increased by six times.

One of the problems connected with the implementation of the CC requirements in holdings occupied with the production of cereals in Poland, is the great quantity of units occupied with this production (in varied scale - both large acreage, specialist farms which produce cereals alone and small ones, whose production is varied and mostly for personal use). Details have been presented in Table 76

Table 76: No of farms with cereals production

Yield	No of farms
Winter wheat	849 550
Spring wheat	387 115
Rye	792 141
Winter barley	155 344
Spring barley	501 450

[40] Due to the relatively low soil requirements rye is a good plant to cultivate in Poland. Nevertheless, the decreasing tendency in rye acreage has been observed in Poland for 50 years.

Yield	No of farms
Oats	560 399
Maize (corn)	110 397
Maize (feed)	100 497

Source: Own calculation based on the Statistical Regional Data Base

The data shows that over a million of agricultural holdings in Poland will have to fulfill the CC requirements on cereal production. As already mentioned, this will have an impact not only on investment costs related to holding adjustment to the CC requirements but also on operational costs for using this measure in Poland (e.g. a large number of necessary controls).

14.2 The beef sector

Animal production in Poland is extremely dispersed – cattle is bread in 934.9 thousand agricultural holdings. Only 0.5% of the holdings owns more than 50 animals, whilst 84% keeps less than 9 animals (Table 77). Around 58 thousand holdings produce solely slaughter cattle.

Table 77: Cattle production structure in Poland in 2002

	No of animals in farm			
	1 - 9	**10 - 19**	**20 – 50**	**More than 50**
Share of production (%)	84,0%	10%	5%	1%

Source: Own calculation based on the results of the National Census (Statistical Regional Data Base)

Slaughter cattle production in Poland is mostly of an extensive character, with the dominating black-and-white breed, and cows from the same stock are used for both meat and milk. The attempt to develop meat breeds has been successful only partially, the stock of cows crossbred with meat breeds is estimated at around 20% of the total cow stock (around 06 million heads) (Rycombel 2005). The quantity of beef production in Poland has been in decline for many years – while in 1977 the stocks numbered circa 13 million and the slaughter rate over 3 million, in 2006 the stocks numbered circa 5 million and the slaughter rate circa 1,2 million.

Due to the decrease in the stock, the livestock density is low in Poland and for cattle equals on average 33 head/100 ha of UAA (in 1990 54 head/100 ha) (MARD 2006). The level of livestock density differs significantly across Poland but in none of the voivodships it exceeds 100 LAU/ 100 ha of UAA. The breeding structure has remained largely unchanged since the 1970s – diary cows account for around 53% of the total cow stock (Lewandowski 2006). Decrease of livestock numbers caused a notable decline in beef production - from over 1 million tons in the beginning of the 90-ties, to 598 thousand tons in 2006.

Lifting of the barriers in the export of the Polish veal to the EU market led to a dynamic increase of the export levels – in 2003 – 2007 by over 100% (Małkowski et al. 2006). At the same time the import of beef did not change considerably.

Analyses show that in the upcoming years one should expect the production of slaughter cattle to increase (Lewandowski 2006). It appears, however, that this growth will depend largely on the domestic demand, as the demand on the European market is rather stable. The possibility for increasing the export of beef is interconnected with lower production prices (lower than the EU average) and conducting of extensive production of slaughter cattle (and based on the requirements of organic farming), which will guarantee a high quality of the meat produced.

14.3 Issues associated with applying CC requirements to cereals and beef

Table 78 provides an overview of the main issues associated with applying the CC SMR requirements to the Polish cereals and beef sectors. Below the Table, where relevant some more details are discussed.

Table 78: Issues associated with application of SMRs to the Polish cereals and beef sectors

Name of legislation	General remark	Cereals sector	Beef sector
Directive 79/409 (Birds)	List of areas which will be protected is not finalized.	Management plans for Natura 2000 sites have not been prepared. Therefore, it is unknown which requirements will have to be implemented by farmers.	The CC requirements implementation will allow for a more effective nature preservation (of the chosen avian species
Directive 80/68 (groundwater)	Middle level of implementation	A large number of holdings do not have space for fertilizer and pesticide storing.	The farm waste disposal is (and shall remain) an issue.
Directive 86/278 (sewage sludge)	High level of implementation	Most of the costs will be covered by the owner of the sludge.	

Name of legislation	General remark	Cereals sector	Beef sector
Directive 91/271 (Nitrate directive)	Low level of implementation		According to the national regulations all holdings (not only those located in the NVZ) should possess manure storage vessels tanks. Significant to high costs are anticipated, which may induce a departure from husbandry in small farms.
Directive 92/43 (habitat)	Lack of the list of areas which will be protected.		
Directive 92/102 (registration of animals)	High level of implementation		To date, a part of the farmers have not registered their animals.
Directive 91/414 (pesticides)	High level of implementation	Most of the costs will be covered by the producers of pesticides	Implementation of the CC will enforce a better cooperation between the institutions engaged in the inspection
Directive 96/22 (hormones)	High level of implementation		
Regulation 178/2002	Fully implemented		Some of producers do not know new requirements. Need for additional training and education.
Regulation 999/2001 (BSE)	Fully implemented		There are issues connected to sample collection form deceased animals.
Directive 2003/86	Fully implemented		It is prohibited in Poland to vaccinate against the foot-and-mouth disease
Directive 2000/75 (blue tongue)	Fully implemented		Lack of cases of the illness in Poland
Directive 91/629 (animal welfare calves)	Middle level of implementation		The previous control covered 7% of farms – problems were identified in 24% of them.
Directive 98/58 (animal welfare pigs)	Middle level of implementation		The previous control covered 4% of farms – problems were identified in 27% of them (the data exists only for chicken). The greatest need of adjustments is in small holdings.

15 Regulation specific issues

15.1 Birds and Habitat Directive

The Bird and Habitat directives are the base for creation of network NATURA 2000. The list of areas of NATURA 2000 network was ready in year 2003, where the areas proposed for conservation were chosen mostly on the basis of archive materials. Unfortunately there were a lot of pressures from the local authorities for Central Government not to include some areas into the NATURA 2000 network. The main argument forwarded by the local officials was that the network will limit the opportunities for economic growth. This opinion has been followed by many of officials from the Central Government. These pressures and associated lobbying activities contributed to the result that the Ministry of Environment designated (and sent to European Commission) only a list of:

- 72 SPA areas with surface of 3312,8 thousand ha (including land ecosystems with surface of 2433,4 thousand ha - 7,8 % area of Poland
- 184 SAC areas with surface of 1171,6 thousand ha - 3,6 % area of Poland.

This selection was criticized by a lot of of the experts. Regarding their opinion and studies Poland should designate 141 OSO areas (with surface of 5622,7 thousand ha) and 279 SOO areas (with surface of 3255,1 thousand ha) to protect all together 18 % of the country area inside NATURA 2000. The European Commission is of a similar opinion and it has initiated a legal action against Poland for an improper designation of Natura 2000 sites. The management plans have not yet been prepared for SPAs and SACs, and therefore, it is unknown what kind of requirements will have to be implemented by agricultural holdings located within these areas. In consequence, it is impossible to estimate implementation costs for these requirements at the holding level. As it is uncertain whether the areas protected within the Natura 2000 network will not change, it is difficult to estimate the number of Polish holdings that will have to fulfill the CC requirements spelled out in the Birds and Habitat Directives.

15.2 Ground water protection Directive

Utilization of machine oil is one of the problematic issues in agriculture. According to the provisions of the Act of 27 April 2001 on waste, each person who owns used-up oil as a result of its economic activity, if unable to regenerate it and/or dispose it on their own, should hand it over to a subject that will guarantee that the oil will be managed according to the existing legislation. The Act forbids to discharge used-up oil to water or soil. Used-up lubricants and oils should be stored in a separate tank and handed over at a petrol station. The provisions impose also an obligation of running a quantitative and qualitative register of

waste[41]. Another solution for getting rid of used-up oil is to exchange it for new oil in an authorized service point. Units that collect used oil usually do it free of charge. The cost of exchanging of used-up oil with new at a diagnostic station is around PLN 50.

15.3 Sewage Sludge Directive

As regards sewage sludge, the volume of sludge produced in Poland is increasing at a fast rate, in 2000, 359.8 thousand ton of sludge was produced in municipal sewage treatment plants and 703.3 thousand ton of sludge was produced in industrial sewage treatment plants. 50.6 thousand ton of municipal sewage sludge and 161.6 thousand ton of industrial sewage sludge were used for agricultural purposes. The agricultural land area where sewage sludge was applied was estimated at around 100 000 ha/year[42]. The imposed restrictions on the use of sewage sludge may generate extra organic fertilizer costs (1,25 Euro/1 kg of N)[43] as some farmers will have to reduce the use of a relatively cheap source of minerals and organic matter. If sewage sludge is utilized, the cost of the tests required by legislation (both of sludge and soil) is covered by the producer of the sludge.

15.4 Nitrate Directive

15.4.1 Compliance with manure handling requirements

As far as the beef sector is concerned, the implementation of the Nitrate Directive will be the most difficult and the most costly for the Polish holdings conducting animal production. This results from two facts: firstly, the majority of holdings in Poland still does not have proper manure dung and liquid manure storage facilities, secondly, the provisions of the Act on Fertilizers and Fertilizing, adopted by the Polish Parliament in July 2000, are in this field much more demanding than the Directive. According to the state legislation, each holding conducting animal production (regardless of the number of animals), and not only those located within vulnerable areas, should have storage facilities for liquid manure (of the capacity allowing for storage for four months) and manure dung. An analysis of agricultural holdings that did not fulfill the requirements of the Nitrate Directive was conducted based on

[41] According to the Code of Good Agricultural Practice, used oils and lubricants from agricultural machines should be stored at a separate tank and handed over at a petrol station or another collection point. Source: *Kodeks Dobrej Praktyki Rolniczej*, MRiRW, MŚ, Warsaw 2004, p. 26 –40.

[42] Beata Kłopotek – interview with a deputy director of the Department of Ecological Policy in the Ministry of Environment.

[43] The cost of nitrogen contained in sewage sludge – 0.25 Euro/kg The cost of nitrogen contained in natural fertilizers (manure dung) – 1.45 Euro/kg

a group of agricultural holdings that were running their agricultural accounting within the FADN in 2004[44]. This group included 11 898 holdings of the economic size of at least two ESU[45]. The results show that the number of holdings that did not fulfill the requirements of the Nitrate Directive accounts for over 10.5% of the whole FADN group.

The share of holdings that did not meet the requirements was the largest in the group of holdings with 'horticultural crops' – 33.4% exceeded the nitrogen dose per hectare of agricultural land. A rather similar share was observed in the group of holdings with animals fed with concentrated feeding stuff where non-compliance amounted to 26% of the total number of holdings in this group. In the group of holdings with grazing animals 27.4% exceeded the required nitrogen dose introduced into a land unit in fertilizers. This means that the number of holdings that do not meet the Nitrate Directive in the group of the Polish FADN is quite considerable.

Detailed results on the number of holdings that do not have storage facilities for manure dung and liquid manure do not exist. According to preliminary estimates, around 75 – 80% of holdings conducting animal production do not have such facilities. This means that 700 – 750 thousand holdings that own cattle should invest in such facilities. For the purposes of this project the cost of construction of such installations has been calculated at the level of Euro 0.09 kilo of produced beef[46].

The Act on Fertilizers and Fertilizing, which was introduced in 2000, was the first Polish legislative act that addresses the issues related to storage and management of fertilizers and it was introduced to adjust the Polish law to EU requirements. Provisions for implementing the requirements of the Nitrates Directive regarding the designation of vulnerable areas and the monitoring of waters endangered by pollution from agricultural sources are contained in the Water Act. The Water Act also indicates the institutions that will be responsible for the implementation of the individual provisions. Poland designated 21 vulnerable areas with the total area of 6263,25 km^2 (2% of country territory). There are a special requirements for the agriculture practice, they are under the standards have to be implemented by farmers on the other areas (outside of nitrate vulnerable areas). Therefore for each area directors of the regional board of water management have prepared an action program with goal to reduce effluent of nitrates from agricultural sources. Action Programs were published as a regulation of the Director of the Regional Board of Water Management. These are acts of domestic law,

[44] Source: The analysis by Dr Grażyna Niewęgłowska: *Zbiorowość gospodarstw rolnych nie spełniających wymogów dyrektywy azotanowej w świetle danych FADN*, [in:] „Z badań nad rolnictwem społecznie zrównoważonym (3)", ed. J. St. Zegara, IERiGŻ PIB, Warsaw 2006.

[45] The value of a standard gross margin generated within a holding, larger than Euro 2400.

[46] The following assumptions were made: the holding has a herd of 15 cows kept in shallow cowshed, the interest rate for the refinancing loan is 4.5% (the depreciation period of 22 years). Changing the assumptions may change the cost of construction per unit of produced beef. In general, it should be assumed that the cost will be higher in holdings with a lower number of animals, whilst in holdings with a larger number of animals it will be lower. The cost will be higher also in holdings conducting production in the no-bedding technologies.

and their provisions are binding for all users of environment that conduct activities within a particular zone. As in Poland there are no holdings that would apply over 170 kg N/ha, the requirement will not have an impact on the method of agricultural production.

15.4.2 Crop rotation requirement

The obligation of crop rotation and the obligation to cultivate plants with high nitrogen demand after cultivation of leguminous plants may result in certain costs (forgone benefits) although this is not necessarily so. Farmers will also have to bear the costs of preparation of fertilization plans for their holdings (around PLN 200/ holding). Around 25 – 30 thousand holdings that cultivate cereals within vulnerable areas will have to cover these costs.

15.5 Identification and registration

Since 2003, the Agency for Restructuring and Modernisation of Agriculture (ARMA) has been maintaining a register of livestock with identification, i.e. cattle, sheep, goats and pigs, which has constituted a basis for development of the System for Identification and Registration of Animals (SIRA). Until 31 December 2005, the Agency issued free of charge registration books and additional sheets to the books, according to the order of applications.[47] Since 1 January 2006, animal owners have to purchase the books and sheets by themselves.

The cost of running the register relates to farmers' work time. Is has been estimated that running a register for one animal takes two hours[48], whilst the value of this work was set at the level of PLN 9.6/animal[49]. On 30 January 2006, 6 376 261 cattle were registered in the SIRA with the status 'alive'. This means that almost whole cattle population in Poland has underwent identification. Only newly born calves are being registered.

15.6 Food safety

As regards food safety, rules relating to animal produce are regulated by the provisions of the Act of 16 December 2005 on Animal Produce (Dz. U. No. 17, item 127) and three implementing regulations to the Act. Safety control is conducted at the poviat, voivodship and state level. The experience so far shows that the awareness of producers and traders in matters of food safety is low. Therefore it is necessary to conduct training. The costs will be

47 Act of 6 May 2005 amending the Act on the system for identification and registration of animals
48 Own assessment based on the interviews with farmers
49 According to the CSO, Profession structures according to wages in October 2004

covered mainly by administration and producers, which will have impact on the final costs of products at the market but will not influence the competitiveness of holdings or the sector.

15.7 Animal welfare

Regulations on animal welfare are specified in Poland in five implementing regulations of the Minister of Agriculture and Rural Development. According to these provisions, animal welfare can be verified against the following factors: good health, proper development and maturation, proper fertility, proper productivity, diversification of proper behavioral forms, including signs of experiencing pleasure. The issues of animal protection are regulated in Act of 21 August 1997 on Animal Protection and in two regulations of the Minister of Agriculture and Rural Development. The Act regulates the treatment of farm animals. According to the Act, the Veterinary Inspection supervises the observance of animal protection provisions, in cooperation with social organizations and the State Ethical Commission for Experiments on Animals if necessary.
In 2004, the State Veterinary Inspectorate conducted a control of holdings that kept calves. Shortcomings were observed in 24% of the analyzed holdings and they related mainly to register keeping, supervision and farm buildings. In the case of buildings, less than half of them fulfilled the requirements on ventilation and lightening. Adjustment costs were estimated at the level of around PLN 20 thousand/holding[50]. The analysis of adjustment of farm buildings to the requirements on animal welfare shows that the largest concordance is observed in large specialized animal productions, whilst the lowest degree of non-compliance is found in small farms with mixed production.

15.8 Specific issues faced in the beef sector

When analyzing the impact of CC on the gross margin and profitability of slaughter cattle production in Poland attention should be first given to the small scale of production. The production of beef was in steady decline from the beginning of the 1990s to 2003. In 2004, however, it increased to the level of around 600 thousand ton and it stabilized at this level. This should be connected with the EU accession and the increased sales at the EU market. Quite a small demand at the domestic market led to low prices, which resulted in low production profitability. Mostly animals of milk breeds were slaughtered, where meat production has a derived or by-product character. The stock of milk/meat breeds was, on the other hand, very low. The EU accession instigated price increases, which in turn led to higher profitability of slaughter animal production. Despite the higher sales at the EU market no

[50] Zespół SAEPR, 2006: Wstępna analiza instrumentu cross compliance w kontekście przyszłej implementacji w Polsce. Sekcja Analiz Ekonomicznych Polityki Rolnej FPPR. Warszawa

significant increases in beef production are expected. Production is expected to remain rather close to the 2006 level.

The CC implementation will result in a slight increase of labour outlays in the holdings producing slaughter cattle. This, however, will not lead to any changes in the gross margin or production profitability in the holdings of physical persons – just as in the case of holdings with cereal production. Slight changes in the gross margin and profitability may occur due to the CC implementation only in the holdings that hire labour force.

The increase of tangible outlays related to the construction of storage facilities for manure dung and liquid manure as well as to scattering of liquid manure over fields may, according to the calculations, lead to an increase of direct costs of slaughter cattle production in medium-size holdings by the total of around Euro 0.10 per 1 kilo of slaughter weight, i.e. by around Euro 100 per 1 tonne of bellies. The costs will increase by around Euro 23.40 per one animal of 450 kg. This means that direct production costs may increase by around 10 – 12%.

The necessity to adjust farm buildings to the needs of animal welfare will impose considerable costs on holdings. It appears, however, that mainly small holdings, which have been conducting mixed production for many years, will have (in a relative sense) to bear main costs. There is no sufficient ground to estimate how these costs will impact the sector's competitiveness, the gross margin and the profitability of individual agricultural holdings.

15.9 Specific issues faced in the cereals sector

As regards the cereals sector, the introduction of CC requirements is not likely to have a significant impact on the gross margin nor on the profitability of holdings that cultivate cereals. A great majority of the measures provided for by the system are already obligatory for Polish farmers, e.g. disposal of pesticide packaging and machine oil or technical inspections of the equipment used for pesticides. Farmers that conduct production within areas vulnerable to nitrates will have to bear the costs of preparation of fertilization plans and analysis of nutrient content in soil as well as the costs of counter-erosion measures within LFAs. A rather small number of holdings conduct production within areas vulnerable to nitrates, whilst farmers conducting production within LFAs already receive increased payments. Attention should be given to the increasing concentration of the production. On the one hand the acreage cultivated with cereals has been increasing in Poland, on the other, the number of holdings conducting cereal production has been diminishing. This means that small farms that are usually managed by physical persons that are at the same time their owners abandon this type of production. Large farms, frequently owned by legal entities (especially large-scale farms managed as a private partnership or a limited liability company) expand the acreage cultivated with cereals.

16 Lessons and conclusions

It is tempting to draw some general lessons from the Polish experience. However, since the character of the Polish agriculture is different from that in the remaining EU countries, one should be careful with generalisations. Nevertheless, there are several issues where other EU countries (especially new MS) can benefit and learn from Poland's experience[51].

A first observation is that CC implementation is difficult from the institutional point of view as it requires abandoning the sectoral approach to economic management and strengthening of cooperation between institutions responsible for various areas of administration – rural development, agriculture, nature and environmental protection, water management, social policy, etc. Only common operation of these institutions will guarantee that the system developed will be based on requirements that are possible to fulfill, will be easy to control and enforce. It is also important to ensure public participation in the process – considering the experiences of farmers and organizations representing them may allow to avoid making mistakes, or at least to decrease the number of conflicts and the extent of criticism pertaining to the new obligations.

Secondly, cross-compliance implementation will require significant educational effort. The slow pace of work in the introduction of this measure in Poland results, among others, from the concern that the new requirements will diminish the level of farmers' support for the European integration and the governing coalition. This results indirectly follows from the low level of farmers' knowledge on the Common Market requirements and the necessity of environmental protection in agricultural activities. The level of environmental awareness, among farmers, the whole society and also among politicians in Poland (as in all the new EU member states) is very low. Consequently, environmental protection is not given priority and sometimes has very low social support. Acceptance for such type of activities may be increased by development of environmental education, showing that environmental conditions of agricultural production influence yield quality, and in consequence, consumer's health as well as drawing attention to social benefits (also for farmers) that will be brought by environmental, sanitary and animal welfare requirements.

Implementation of new requirements necessitates time. Societies of the new member states underwent in last two decades a lengthy and substantial transformation process – first the system transformation and next the economic transformation (from the centrally planned to the free-market economy) and finally, the transformation related to the adjustment to the

[51] The dissemination activity included in this project required organizing seminars in three new member states. Seminars were held in Lithuania, Poland and Hungary. These seminars (which are separately reported on in Deliverable 18 of this project) further emphasized the similarities in challenges the new member states are faced with when implementing and applying cross-compliance.

provisions and procedures binding in the European Union. This process covered also farmers, who had to adjust the management of their farms to the new conditions. In Poland, farmers constituted one of the few social groups who did not benefit for a long time from the transformation process. This situation changed only after the EU accession and opening of the CAP measures. Farmers expect that the harmonization of the state agricultural policy with the Common Market conditions will guarantee them greater transparency and stability of this policy. Therefore, they should not be surprised by an introduction of new solutions to which they have to adjust in a very short time. This holds true even when the cross-compliance requirements (GEAC and SMR) are not viewed as new obligations for farmers in new member states. What will change are the consequences of failing to implement the CC requirements.

For implementation a transition period of a certain length is necessary due to the fact that the adjustment to the new regulations will require farmers (or at least a significant part of them) to conduct investments (frequently costly – e.g. implementation of the requirements of the Nitrates Directive or animal welfare provisions) or organizational/production changes. The adjustment time will allow farmers to better plan for the necessary activities that have to be undertaken at the holding level and to better link up investments necessary for meeting standards with those aimed to further rationalize production.

Polish experience suggests also that cross-compliance introduction may force holdings to specialize (although at the moment there is no empirical data that would confirm this claim). It should be expected that at least part of the farmers that conduct mixed production, when forced to carry out adjustment investments, will choose only one, from their point of view the most profitable direction of the future production, in order to decrease the costs of the investments and will adjust their holdings to the CC requirements only for this type of production. In future, in order not to lose the right to direct payments, they will abandon all other production to which the holding has not been adjusted. This should serve as a guidance for the governments of the countries who plan to support the specialization of agricultural production.

The explorative analysis of the Polish case shows that the level of readiness for the implementation of the full cross-compliance requirements is not advanced. Although the EU provisions containing SMR have been transposed to the Polish legislation and are binding, the level of farmers' knowledge on the direction of changes in the agricultural policy is currently still very low. There is, at least until recently, not much discussion on how and why farmers should adjust to the new provisions or on the future consequences that will have to be born by farmers who will fail to obey the GEAC and SMR. Up till now farmers are not well-informed or educated about these matters. What is especially lacking is an explanation of which SMRs will have to be fulfilled by Polish farmers and to what extent they should change their holdings so that to be able to meet the requirements in near future. No wider social debate is conducted on the necessity and solutions to implement the CC requirements

in Poland. This may potentially lead in future to social conflicts between public administration and farmers.

The weak preparation to cross-compliance implementation is more surprising given the fact that, as the research shows, it is not likely to result in excessive costs for the analyzed sectors (cereals and beef). Although farmers will frequently have to conduct costly investments and organizational changes, in the scale of the whole country this will not have a significant impact on the gross margin or the profitability of the holdings that produce cereals or beef. Another derived conclusion is that the implementation of the CC requirements is also not expected to have any significant impact on the competitiveness of the analyzed sectors in the EU.

In the cereal sector the new requirements will impose first and foremost new organizational obligations on e.g. proper use of fertilizers, pesticides, utilization of packagings for these chemicals or waste management. Although there is no detailed data in this respect, the existing information shows that most of the holdings have already adjusted to the GEAC requirements and that this did not involve observed large costs[52]. It may prove difficult to implement nature protection requirements. Nevertheless, for now it is impossible to estimate the precise costs that would have to be covered by the holdings with cereal production located within the areas protected under the provisions of the Birds and Habitat Directives. Also for these requirements, however, the costs are not likely to be high (they will occur mostly as forgone possibilities and at least partially will be compensated with payments for the holdings located at the sites of the Natura 2000 network).

Adjustments to the new requirements may be more difficult in the beef production sector. Main costs will relate to the implementation of the provisions of the Nitrates Directive and animal welfare. The number of affected farm (which are obliged to make these investments) may be relatively limited. However, for some holdings, with small production, these costs may prove too high and they may in future abandon animal breeding.

The research shows that the construction of storage facilities for manure dung and liquid manure will have a significant impact on beef production costs. For this reason it would be recommended to maintain co-financing for this type of investments. This is even more important given the fact that the majority of agricultural holdings in Poland do not have free financial resources or loan credibility, which would allow them to solve the problem on their own.

[52] In this context it is important to consider a new threat to the environment that results from the GEAC implementation. Farmers that have meadows and pastures but do not breed any animals have a problem with utilizing the biomass from cutting these areas. Several cases of flooding of biomass in lakes have seen light in recent years. Seeing this problem, public administration tries to counteract against such practices by changing the payment conditions for permanent grassland.

Most probably at least a part of beef producers will apply for the EU funds for adjustment of their holdings to the EU environmental protection and animal welfare requirements. This will significantly reduce their private adjustment costs. The data is, however, insufficient to estimate the size of this group of farmers.

Cross-compliance implementation in Poland will result in significant institutional problems. On the one hand, there are no specialized units that would be prepared to control agricultural holdings with respect to fulfillment of environmental protection and animal welfare provisions. On the other, due to the large number of holdings that will receive in Poland direct payments, the cost of control will considerably increase. Therefore, it would be justified to involve local authorities (at the *gmina* and/or *poviat* level) in the cross-compliance enforcement process. According to the binding legislation, these two public administration levels are to a large extent responsible for preserving environmental values, land management and water and wastewater management. They have not currently been, however, considered as potential institutions that could control and enforce that agricultural production is conducted in line with the CC rules. Their involvement in the control of the CC requirements application could considerably reduce the institutional problems related to the implementation of this measure.

It is very likely that due to the interdisciplinary character of the SMR requirements (which combine environmental protection, hygiene and agricultural issues), their implementation will force the public institutions in Poland that deal with different issues to start cooperating with each other. Lack of such cooperation has been so far one of the obstacles hindering the implementation of the EU requirements. This impact should be seen as one of the important benefits resulting from the CC implementation. Poland is not unique in this. Also in other member states often different institutions are involved in implementing and monitoring cross-compliance. However, in the old member states, there is often a longer experience of the institutional cooperation necessary in this respect, since in comparison with Poland, the SMRs have already a long history there.

Although Polish agriculture is unique also when compared to other new member states, there are significant similarities in the process of implementation. As such a number of observations and recommendations made for Poland will also apply to other new member states.

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