



MANURE, FERTILIZER AND PESTICIDE MANAGEMENT IN CANADA

RESULTS OF THE 1995 FARM INPUTS MANAGEMENT SURVEY (FIMS)

Economic and Policy Analysis Directorate
Policy Branch

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Agriculture and
Agri-Food Canada

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Agroalimentaire Canada

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Abstract

In December 1995, Statistics Canada, in cooperation with Agriculture and Agri-Food Canada, conducted the Farm Inputs Management Survey (FIMS). The survey was designed to contribute to the work being done on the Inputs Management component of the Farm Resource Management Indicator. This indicator forms part of Agriculture and Agri-Food Canada's Agri-Environmental Indicator Project. In a country as large as Canada, agricultural activity can be expected to vary from region to region in terms of commodities produced and management practices used. The survey was a means of addressing national and regional data gaps with respect to farm input management practices. Operators of 6,000 Canadian farms, representing all major agricultural sectors and all major agricultural regions, were asked questions about their manure, commercial fertilizer and pesticide management practices. The survey questions were designed to complement the input management questions that appeared on the 1996 Census of Agriculture. The survey results focus on the ecozone, a geographic area with homogeneous hydrographic, climatic, ecological and topographic characteristics. Though Canada has fifteen ecozones, virtually all of the agricultural activity is carried out in the seven that stretch along the southern part of the country from British Columbia's Pacific coast through to Newfoundland.

Preface

The Agri-Environmental Indicator Project of Agriculture and Agri-Food Canada was initiated in 1993 in response to recommendations made by several agencies, organizations and special studies. The overall objective of the project is to develop and provide information to help integrate environmental considerations into the decision-making processes of the agri-food sector.

The project aims to develop a core set of regionally-sensitive national indicators that build on and enhance the information base currently available on environmental conditions and trends related to primary agriculture in Canada. The Inputs Management component of the Farm Resource Management Indicator is an important part of the Agri-Environmental Indicator set. Indicators are also being developed for other aspects of farm resource management, as well as for water quality, agroecosystem biodiversity, soil quality, agricultural greenhouse gases and agricultural production efficiency.

Research results in the form of discussion papers, scientific articles and progress reports are released as they become available. A comprehensive report is planned for fiscal year 1998-99.

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Executive Summary

Background

Data gaps exist at the national and regional level with respect to how agricultural inputs are managed on farms. Few data have been collected on farm input management practices, specifically the management of manure, commercial fertilizers and pesticides. In 1995, Statistics Canada, in partnership with Agriculture and Agri-Food Canada, conducted a survey examining the input management practices used by Canadian farmers. The 1995 Farm Inputs Management Survey (FIMS) complemented the questions on land management practices that were added to the Census of Agriculture for the first time in 1991. The results of this survey make a significant contribution to enhancing the information currently available on farm input management practices in Canada.

Statistics Canada and Agriculture and Agri-Food Canada have produced a joint publication that provides the results of FIMS at the Canada level. The publication, available from Statistics Canada, is entitled *Farm Inputs Management Survey, 1995*, (Catalogue No. 21F0009XPE). Since this initial report, Agriculture and Agri-Food Canada has undertaken a more extensive evaluation of the results of FIMS. The results of this subsequent evaluation are reported here.

The purpose of this report is to provide more detailed agri-environmental information on a regional and sectoral basis about the practices used for managing farm inputs. The report provides comprehensive results of FIMS at the ecozone level and reviews selected farm input management practices in Canadian agriculture for manure, fertilizers and pesticides. It also provides estimates of the number of producers using specific input management practices. The results of this survey will provide a baseline set of data from which further analysis for the Farm Resource Management Indicator, part of Agriculture and Agri-Food Canada's Agri-Environmental Indicator Project, can be done.

Analytical Framework

Key agri-environmental challenges in the broad areas of manure, fertilizer and pesticide management were identified at the onset of the survey and incorporated in the survey design.

The analysis focuses on the following:

Manure

Manure storage practices used on the farm have environmental and economic implications associated with them. The adoption of storage methods that minimize environmental risks is encouraged. As the livestock sector grows and becomes more concentrated, adequate capacity for the storage of additional manure becomes increasingly important. Data on manure storage type and capacity are analysed by farm type and ecozone.

Manure disposal can present a serious management problem on farms producing livestock. Conversely, on crop land, substitution of purchased fertilizers with manure can be an environmentally sound practice that also provides economic benefits. The report examines manure application practices.

Fertilizers

The issue of nutrient management is a key concern with crop producers. The utilization of an economically efficient combination of commercial fertilizers and manure needs to be balanced with environmental considerations. An effective balance contributes to reductions in the risks of nutrient pollution of ground and surface water while potentially enhancing farm productivity and profitability.

Data on fertilizer application, soil testing, manure usage and other relevant questions about fertilizer management are analyzed by ecozone and farm type.

Pesticides

The report examines such issues as sprayer calibration, use of alternative pest control methods and timing of application. Better managed application of pesticides contributes to reductions in risks such as ground and surface water contamination. Efficient application can potentially enhance farm productivity and profitability while ensuring food and water safety.

Regional Results of FIMS

The comprehensive regional results of FIMS, contained within this report, focus on the ecozones of Canada. These results are more detailed than those in the initial Statistics Canada publication, which concentrated on the national perspective. This report serves as a resource for

readers who would like to further investigate the issues raised in the Statistics Canada publication or to explore other issues related to farm inputs management.

It is important to remember, when examining the FIMS results, that input management practices that are harmful to the environment in one region may not have any negative environmental impacts in another. Environmental impacts are a function of precipitation levels, soil types, landforms and many other variables related to the local geographic area.

Highlights

The following are the highlights of the 1995 Farm Inputs Management Survey:

Manure

- Sixty percent of farms reported that they stored manure on their operations in 1995. About 11% of farms stored liquid manure. This included 19% of Mixedwood Plains farms and 20% of Pacific Maritime farms.
- Dairy and hog operations accounted for 38% and 35%, respectively, of respondents reporting liquid manure storage. The two most common liquid manure storage practices employed by hog farms and dairy farms were unlined lagoons and open tanks.
- Fifty-three percent of respondents reporting liquid manure had more than 200 days of storage capacity and 40% had 251 or more days of storage capacity.
- Liquid manure storage capacity was highest in the Boreal Shield ecozone where 88% of farms had more than 200 days of storage capacity. Sixty percent of producers reporting liquid manure storage in the Mixedwood Plains ecozone had in excess of 200 days of storage capacity. In the Pacific Maritime, Montane Cordillera and Prairies ecozones, at least 70% of the producers reporting liquid manure storage had 200 days or less of liquid storage capacity.
- Ninety-five percent of farms reporting manure storage had solid manure storage. Solid manure was most frequently stored in an open pile without a roof. The manure pack storage method was also common in western Canada.
- In the Pacific Maritime and Montane Cordillera ecozones, about half of the manure produced was applied in the spring. In the Prairies and Boreal Plains, about half of the manure produced was applied in the fall. In the three

eastern ecozones, approximately 35% of the manure was applied in the spring, while 40% to 45% was applied in the fall.

- Very little manure was applied in the winter. Amounts ranged from 1% in the Atlantic Maritime ecozone to 8% in the Pacific Maritime ecozone.

Commercial Fertilizers

- Ninety-two percent of farms reported producing grains, oilseeds, hay or forages. Seventy-two percent of these applied commercial fertilizers to their crops. Over three-quarters of the farmers in the Prairies and Mixedwood Plains applied commercial fertilizers while only half of the farmers in the Boreal Plains used commercial fertilizers.
- Generally, commercial fertilizers were broadcast onto fields in the predominantly non-grain-growing areas. Application with seed was used most often in the Prairies and Boreal Plains. Banding was also significant in these two ecozones.
- Only 35% of farmers applied commercial fertilizers to land that had received manure application. The figures were somewhat higher in the Mixedwood Plains and coastal regions.
- Of those farms that applied fertilizer to manure-treated land, almost all outside of the Prairie Provinces reduced fertilizer use to offset manure application. Within the Prairie Provinces, only about three-quarters of the farmers reduced fertilizer amounts to offset nutrients from manure.
- Sixty-seven percent of farms used nitrogen fertilizer. The greatest use was in crop growing regions of the Prairies and Boreal Plains ecozones.
- Nationally, 53% of the nitrogen fertilizer was applied before planting. Timing of nitrogen application varied across ecozones. About one-quarter of the nitrogen fertilizer was applied before planting in the two coastal ecozones while almost two-thirds was applied before planting in the two Prairie Province ecozones.
- Few farmers used legume ploughdown (15%).
- Soil testing was consistently the most common method of deciding on the type and quantity of fertilizer to apply. Across all ecozones, 60% to 70% of farmers conducted soil tests. The Boreal Plains ecozone was an exception, with

only half of the farmers conducting soil tests. The largest group of farmers in every ecozone conducted soil tests only every 2 to 3 years, though about one-third did soil testing every year.

Pesticides

- Sixty-seven percent of all crop producers applied herbicides to control weeds. In the crop-growing Prairies ecozone, 83% of farms used herbicides.
- Farmers most frequently chose to apply herbicides on the basis of crop growth stage. The first appearance of weeds was also an important trigger for herbicide application.
- Only 31% of farms used insecticides and only 19% used fungicides. Application of these pesticides was generally triggered by unspecified “other” reasons. Farms in both coastal ecozones applied insecticides and fungicides at the first sign of pests and diseases.
- Seventy-six percent of crop producers operated their own sprayer. The recommended practice is to calibrate the sprayer between applications of different pesticides. Of all farms reporting sprayer ownership, 68% calibrated their sprayer only at the start of the crop season while just 20% followed the recommended practice. Farmers in the Pacific Maritime ecozone tended to calibrate their sprayers between applications of different pesticides to a greater extent.
- Crop rotation was the most common nonchemical pest control method. However, 39% of farmers reported using only chemical pest control methods and did not make use of any nonchemical methods.

Report Structure

This report is structured as follows. The *Introduction* contains a discussion of the procedures used to conduct the 1995 Farm Inputs Management Survey. The section following the *Introduction* provides an overview of the survey results on an ecozone basis relating to manure, fertilizer and pesticide management practices. This is followed by the *Conclusion*. Finally, a series of appendices provide supplementary information about the Agri-Environmental Indicators, the Farm Inputs Management Survey and the major agricultural ecozones. A detailed description of the survey methodology, including a discussion of issues regarding stratification, sample size, estimation procedure and data reliability can be found in Appendix B. Also, the *Estimation* section in Appendix B, in particular, contains important information for the correct interpretation of the survey results.

Introduction

Background

The use and management of farm inputs, such as manure, fertilizers and pesticides, have important impacts on agricultural sustainability and the environment. Effective use of farm inputs can contribute to improved agricultural sustainability by minimizing environmental risks, and can also contribute to enhanced farm profitability through more efficient utilization of costly inputs. Proper application of herbicides on the Prairies, for example, allows for a reduction in summerfallow tillage, which may subsequently result in reduced soil erosion and oxidation of soil carbon. Conversely, water quality, soil quality and biodiversity can be adversely affected by the improper use and application of agrochemicals and livestock manure. The proper management of farm inputs is further complicated by the great regional diversity in agronomic conditions. This diversity influences not only cultural practices, but also the type of agriculture that occurs. For example, beef and hog production occur across Canada, but management practices differ between the small farms of the Maritimes and the extensive operations of the Prairies. Furthermore, while dairy and poultry production are most prevalent in eastern Canada, crop production prevails in the Prairie Provinces.

Farm inputs management is one of the key factors that affect agroecosystem sustainability. One of the strategies used by farm managers to optimize the use of farm inputs and manage environmental risks is the application of Best Management Practices (BMPs). There are a wide variety of definitions of BMPs because of the different ecological and agronomic conditions from region to region. However, they all encompass similar objectives: managing production systems to achieve environmental goals while maintaining acceptable levels of economic returns. Examples of BMPs for farm inputs include regular soil testing, integrated pest management (IPM) and manure runoff containment. BMPs vary from farm to farm according to the physical, financial and technological components unique to each operation.

To assess sustainability, there is a need for analysis on a regional basis given the variability of input management practices within farm types and among regions. However, little data are available to track the extent of adoption by farmers of selected BMPs for manure, fertilizers and pesticides. Only a few provinces collect information on farm input management. To

consider how this data gap might be addressed, an interdisciplinary committee was formed to look at the issue of data collection. The committee decided that a survey among farmers was the most effective method of obtaining inputs management information.

Farm Inputs Management Survey (FIMS)

In December 1995, Statistics Canada, in partnership with Agriculture and Agri-Food Canada, conducted a telephone survey examining input management practices used by Canadian farmers. FIMS complemented the questions on land management practices that were added to the Census of Agriculture for the first time in 1991 and the manure management questions that were added in 1996. The results of this survey make a significant contribution to enhancing the information base currently available on environmental conditions and trends related to primary agriculture in Canada. After the survey, Statistics Canada and Agriculture and Agri-Food Canada produced a joint publication that provided the results of FIMS at the Canada level. Since this initial report, Agriculture and Agri-Food Canada has undertaken a more extensive evaluation of the results of FIMS which appear in this report.

The objective of this analysis is to review selected farm input management practices in Canadian agriculture that are related to current agri-environmental issues. The report provides detailed results of FIMS at the ecozone level as they relate to current farm input management issues. This report also contributes to the Agri-Environmental Indicator Project at Agriculture and Agri-Food Canada. The results of this survey will provide a baseline set of data from which further analysis for the Farm Resource Management Indicator can be done.

FIMS was conducted between December 6 and 20, 1995 on a sample of 6,000 farms. With harvest completed, this time was less hectic for producers than other times of the year, but recent enough after the crop season that facts about various farm practices used during the season could still be recalled. As a result, the response rate of the survey was high at 93%. The target population of FIMS consisted of all farms in Canada that were in operation at the time of the survey, excluding the Yukon and Northwest Territories. Because of certain constraints on data collection, some farms were excluded from the population.

The survey questions were developed in consultation with various interested parties that included both the private and public sectors and reflect the environmental concerns of the participating groups with respect to farm inputs. Statistics Canada maintained strict adherence to survey and sampling theory. The level of accuracy of the estimates can be tested empirically using statistical techniques such as the coefficient of variation. As such, users of the data can have confidence in the survey results. However, there are areas where the survey results should be used with some caution. The use of a telephone interview technique does not provide the confirmation of visual observation available with a personal interview. FIMS contained several potentially controversial questions, distance of manure storage from wells and water courses being among them. There exists the potential for the results of these types of questions to understate the actual environmental problem because an interviewer was not actually present to confirm the results.

Farm Types

Much of the analysis that follows makes use of Statistics Canada's concept of farm type, a means of grouping farms producing similar commodities. Farm type reflects the agricultural activity that generates 51% or more of the market revenues on the farming operation. For example, a farm that receives 51% or more of its market revenues from the sales of milk and dairy products is considered a dairy farm. Categorizing farms by farm type does not exclude the consideration of secondary commodities in the survey results. Livestock farms were still asked the questions on fertilizers and pesticides if they reported land in crops. In such cases, the number of farms "reporting" crops is much higher than the number of grain and oilseed farms.

Analysis of data by farm type is especially important in the context of farm input management because different types of production make use of different farm inputs. Grain and oilseed farms typically use relatively high levels of fertilizers and pesticides. Grain producing areas may suffer particular environmental problems because of the use of these inputs. Livestock areas, on the other hand, are more likely to face environmental risks resulting from manure storage and application problems.

Ecozones

This report focuses the analysis of FIMS at the ecozone level. The ecozone is the most aggregated level of a country-wide ecological land classification hierarchy that begins at the most detailed level with approximately 4,000 soil landscape polygons. These soil landscape polygons can be aggregated into ecodistricts, ecoregions and ecozones. Each ecozone is also an approximate grouping of census enumeration areas sharing common ecological and environmental characteristics. Figure 1 on page 5 contains a map that shows the boundaries of Canada's 15 ecozones. For a more in-depth description of the ecozones of Canada, refer to *A National Ecological Framework for Canada (Ecological Stratification Working Group, 1995)*. This report provides a detailed explanation of the various ecozones and ecoregions of Canada. Excerpts of this report were taken to describe the ecozones listed in Appendix C.

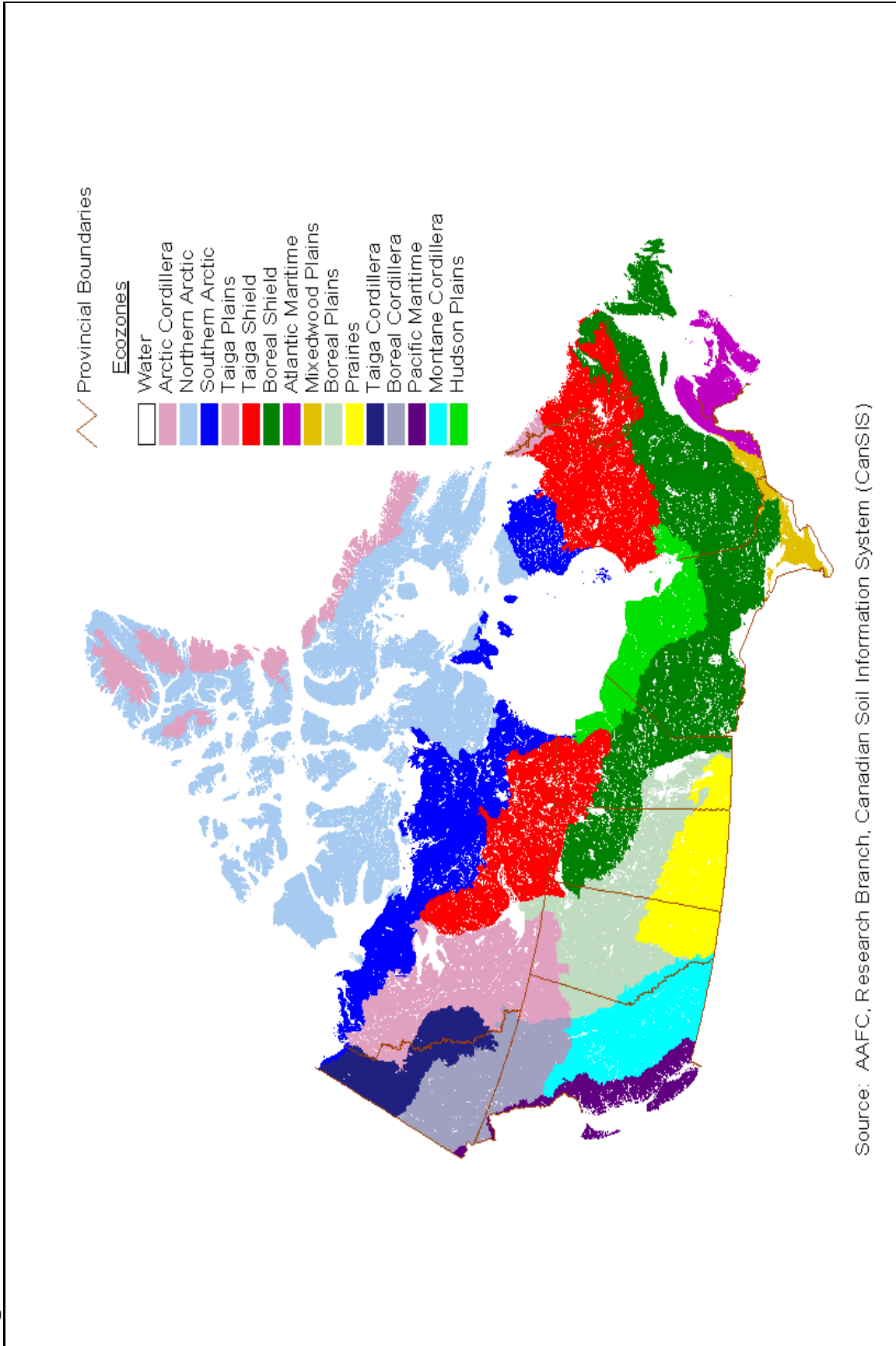
Only those ecozones with a significant level of agricultural activity and a large number of farming operations are included in the analysis. The following ecozones are examined: Pacific Maritime, Montane Cordillera, Prairies, Boreal Plains, Mixedwood Plains, Boreal Shield and Atlantic Maritime. Each ecozone has its own unique set of ecosystem attributes which affect agronomic conditions and cultural practices. These ecological differences are important in the context of farm input management because they affect the predominant types of agriculture that are carried out in the ecozone, as well as the management practices that are used. It is important to remember, when examining the FIMS results, that input management practices that are harmful to the environment in one region or ecozone may not have any negative environmental impacts in another. Environmental impacts are a function of precipitation levels, soil types, landforms and many other variables related to the local geographic area. It is important to note that agricultural activity is not always distributed uniformly across an ecozone. Farms are distributed fairly evenly across the fertile growing belt of the Prairies ecozone in terms of number and intensity of production. Conversely, within the large area of the Pacific Maritime ecozone, an intensive level of agricultural activity occurs almost exclusively within the limited agricultural confines of the Fraser Valley.

Survey Estimation and Data Quality

Estimates of the number of farms, especially totals, may vary slightly from place to place in the analysis. For example, the total number of farms is reported as 224,060 in Table 1 on page 11 and as 224,045 in Table 2 on page 14. The small difference in farm numbers is the result of the procedures used to expand the survey results from the sample to the entire population. Each farm in the sample represents other similar farms in the whole population. Each survey record has an associated weighting factor, which is used to expand the survey results to the total number of farms. Therefore, the number of farms that is published is not the true number, as would be obtained from a census, but an estimate of the true number based on a much smaller sample. Inherent in this estimation of the population result is some degree of error, which when used in the statistical sense, does not imply that the result is wrong, but refers instead to potential variation. In addition, all estimates of farm numbers are randomly rounded to the nearest zero or five, the subsequent survey estimates also being adjusted accordingly. These two sources of variation cause the estimates of farm numbers to differ in different tables and graphs, particularly when several estimates are aggregated to a total.

The potential error in each estimate can be calculated from the sample itself using a statistical measure called the coefficient of variation (CV). The CV is defined as the standard error of the estimate divided by the survey estimate. It is a measure of relative precision and is expressed as a percentage. CVs have been calculated for every estimate, though they have not been published here. In general, a larger number of responses implies a better CV. Therefore, CVs tend to be good, less than 10%, particularly for ecozones with a large number of farms such as the Prairies and Mixedwood Plains. CVs, though generally good, tend to be more variable for results from ecozones with a smaller number of farms.

Figure 1: Terrestrial ecozones of Canada



Source: AAFC, Research Branch, Canadian Soil Information System (CanSIS)

Results of the Farm Inputs Management Survey (FIMS)

Management Practices for Manure, Fertilizer and Pesticides

This section of the report presents the detailed results of the 1995 Farm Inputs Management Survey. It is primarily intended to serve as a resource for readers who are investigating the environmental impacts of currently-used farm inputs management practices. Care should be taken, though, about drawing causal links between particular input management practices and environmental problems. This analysis only reports the techniques and management practices that are used and makes no assessment about the practices with respect to environmental issues.

The presentation focuses on each of the seven ecozones of Canada that have significant levels of agricultural activity. Section 1, "Farm and Farm Operator Profiles", on page 8 is a discussion of the profile of the farms and farm operators by looking at variables such as farm type, farm size, operator education and operator age. It is important to understand the composition of the farms in the sample to have a better appreciation of the principal results of the survey. Section 2, "Manure Management", on page 17 presents the information pertaining to manure storage and application. Section 3, "Commercial Fertilizer Management", on page 29 presents the information pertaining to commercial fertilizer use and nutrient management and Section 4, "Pesticide Management", on page 38 presents the information concerning pesticide use. The analysis goes through each of the questions related to inputs management, highlighting similarities and variations among the various ecozones. Where it is pertinent, the data are also subdivided by farm type to indicate different management practices that may exist among the different sectors within ecozones.

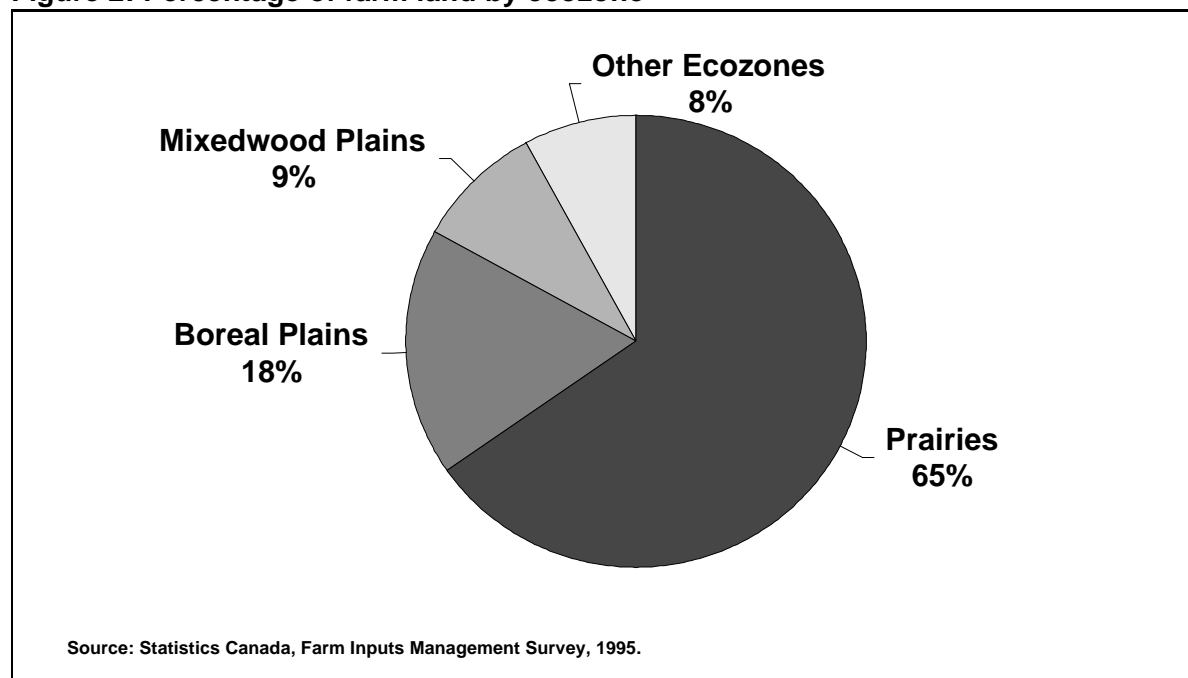
Section 1: Farm and Farm Operator Profiles

The following section looks at the characteristics of the farms that responded to FIMS. The farms are broken down by a number of financial, physical and demographic variables. Financial variables relate to farm revenues and primary commodities produced. Physical variables relate to farm size and the number of farms within an ecozone. Demographic variables include age and education level of the operator responding to the survey. These types of variables are useful for categorizing farms within each ecozone so that further analysis can reveal trends and practices in inputs management.

Farm Land Area and Land Use

The first survey result to consider is the farm land area within each ecozone. Farm land area becomes important when discussing results such as manure application and fertilizer use. Farm land area is calculated on the basis of the farms that make up the FIMS sample. Since there are certain types of agricultural operations that are excluded from the sample, not all farm land is included in the estimates. As a result, the estimates of total farm land area may differ somewhat from other data sources. The results that appear in Figure 2 give an indication of the extent to which the land base on farms covered by the survey is distributed among the ecozones.

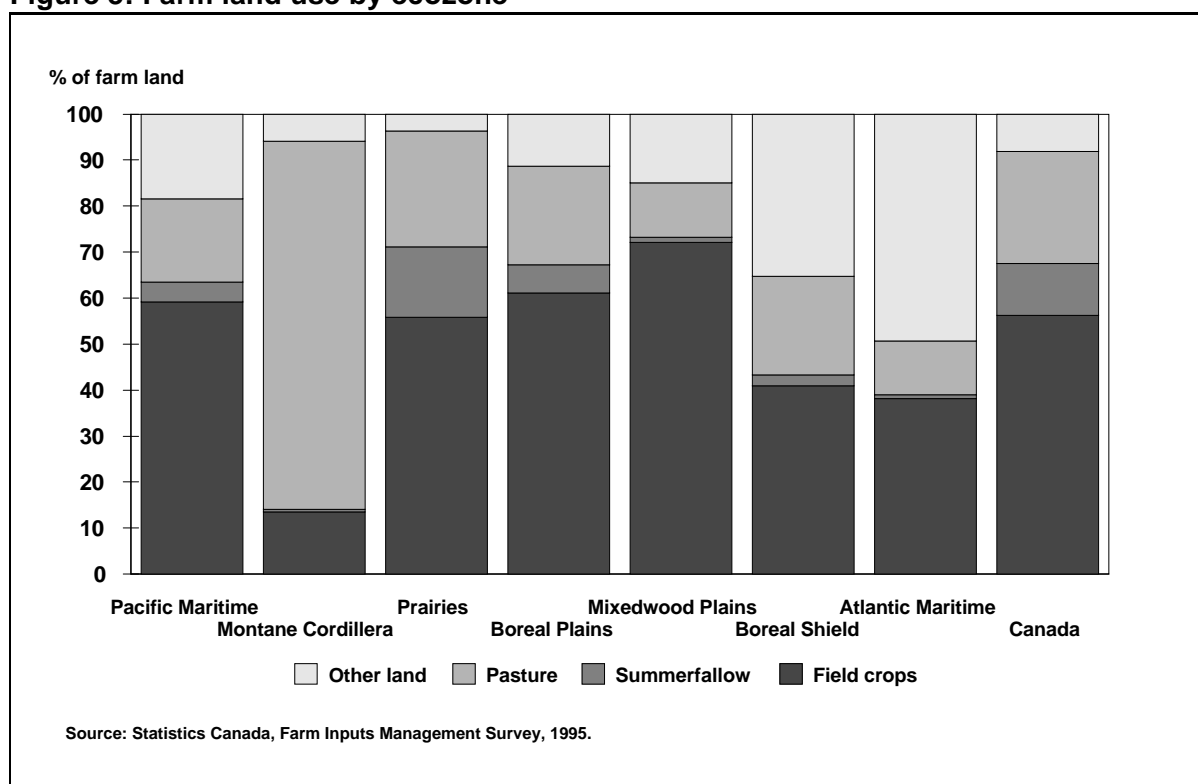
Figure 2: Percentage of farm land by ecozone



The Prairies, the Boreal Plains and the Mixedwood Plains ecozones, respectively, have the largest farm land areas. No other ecozone contains more than 3% of the farm land covered by the survey. The Prairies ecozone itself contains the largest amount of farm land, almost two-thirds of the Canadian total. Together with the Boreal Plains, the Canadian Prairie region contains 83% of the farm land area covered by the survey.

Figure 3 provides insight into farm land use patterns within each ecozone. Generally, the greatest use of farm land in each ecozone is for field crops. This is particularly true for the ecozones with large agricultural land bases such as the Boreal Plains and Mixedwood Plains. Because of conventional dryland farming practices, farms in the Prairies ecozone maintain a lower proportion of farm land in field crops and a higher proportion in summerfallow. Summerfallow area is significant only in dryland grain farming areas of the Prairies ecozone. The most noticeable exception to the general farm land use pattern occurs in the Montane Cordillera, a predominantly beef producing region. The greater part of the farm land base here consists of pasture. Almost half of the farm land in the Atlantic Maritime falls in the “other” category which consists primarily of farm yards, nonproductive land and woodlots.

Figure 3: Farm land use by ecozone



Distribution of Farms by Farm Type

Farm type is perhaps the most important classification variable because of its relationship to the types of inputs found on the farming operation. Generally, fertilizers and pesticides are used most often on crop-type farms while manure storage and disposal are required on livestock-type farms. Figure 4 on page 10 shows the number of farms in each ecozone, providing an alternative view of the agricultural importance of each region. The largest number of farms are found in the ecozones with the largest farm land areas. More than 80% of all farms are located in just two agricultural regions; 53% of farms are in the Prairie region consisting of the Boreal Plains and Prairies ecozones; a further 30% of farms are in the Mixedwood Plains ecozone of southern Ontario and Quebec.

Figure 4: Number of farms by ecozone

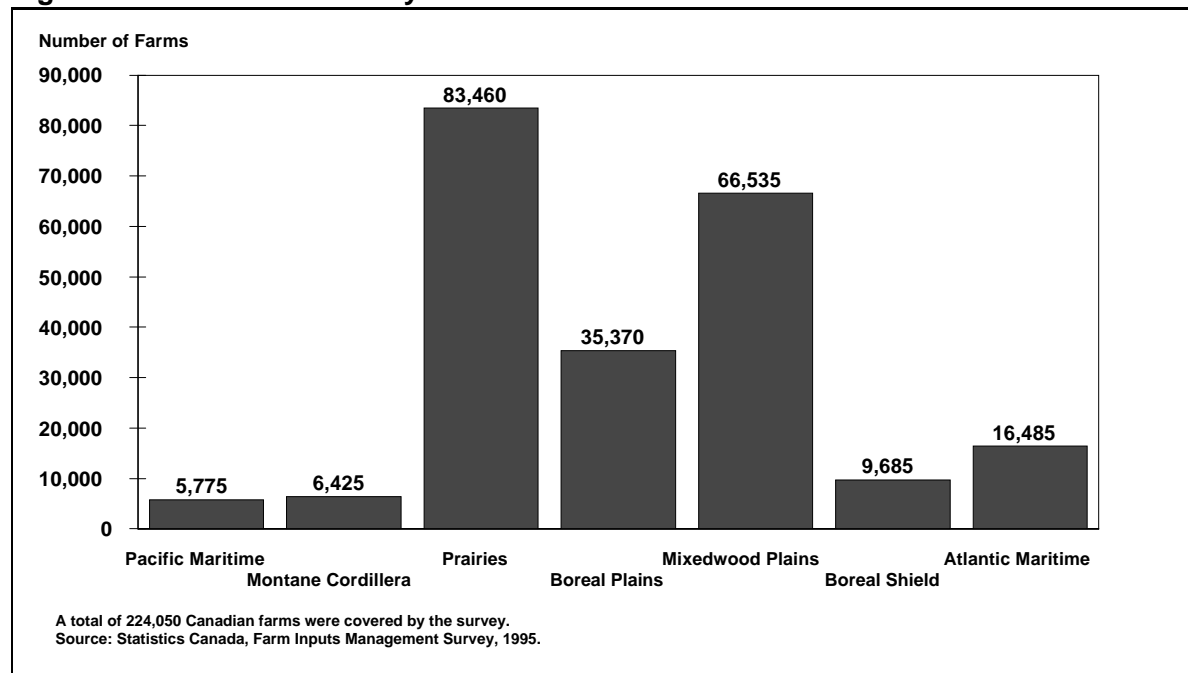
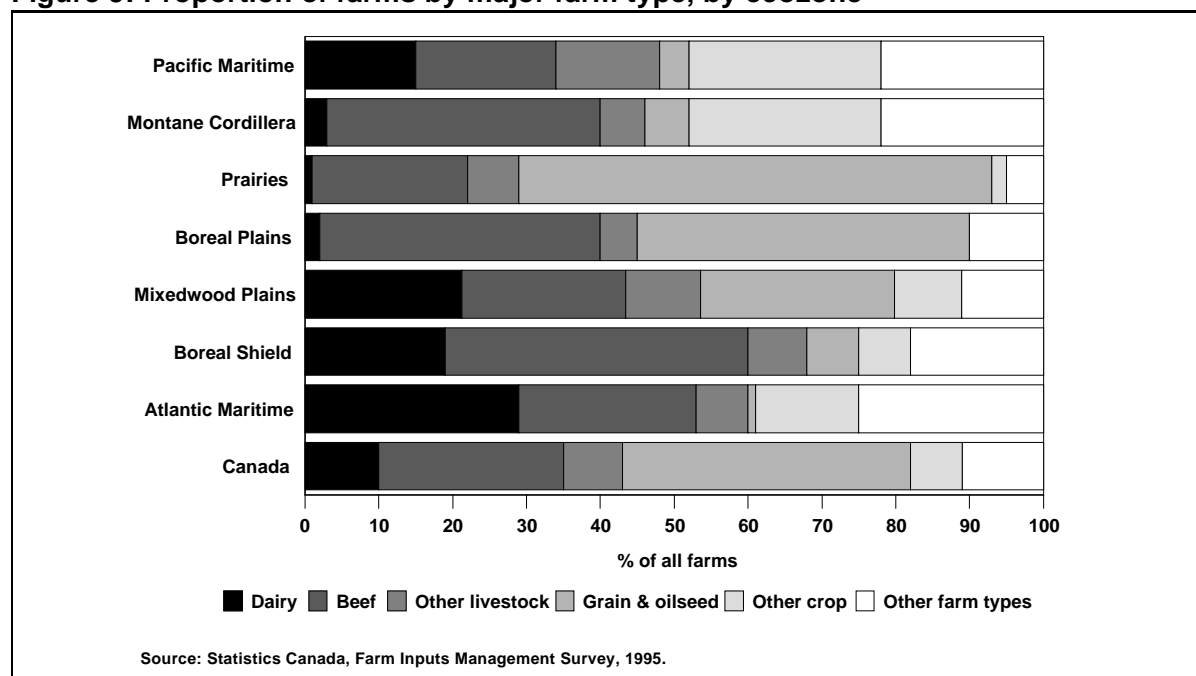


Figure 5 shows farms classified by farm type as a percentage of total farms in each ecozone. The three principal commodities produced are grains, oilseeds and beef cattle. Grain and oilseed farms account for 39% of all farms. Approximately 64% of farms in the Prairies ecozone have grain and oilseed production as their major agricultural activity. The production of grains and oilseeds occurs to a large extent in the Boreal Plains (45%) and the Mixedwood Plains (26%) ecozones as well.

Figure 5: Proportion of farms by major farm type, by ecozone



One-quarter of all farms list beef cattle production as their primary enterprise. Beef cattle farms are located in high concentrations in the Boreal Shield (41%), the Boreal Plains (38%) and the Montane Cordillera (37%) ecozones. Approximately 21% of all farms in the Prairies ecozone have beef cattle production listed as their major agricultural activity, a lower percentage, but a higher actual number. On the other hand, dairy production occurs mainly in the Atlantic Maritime (29%) and Mixedwood Plains (21%) ecozones. In terms of numbers, the Mixedwood Plains contains 13,860 dairy farms, 59% of the total number of dairy farms in Canada.

Table 1 lists the number of farms by farm type in each ecozone. Looking at some of the other farm products, fruit and vegetable production is concentrated in the Mixedwood Plains with 48% of all fruit and vegetable farms in that ecozone. Potatoes are grown mainly in the Atlantic Maritime ecozone, which has 57% of all potato farms. More than 97% of all tobacco farms operate in the Mixedwood Plains. Poultry and egg farms are also highly concentrated in the Mixedwood Plains ecozone (58%). Hog farms are more dispersed between the Mixedwood Plains (45%), Prairies (27%), Boreal Plains (12%) and Atlantic Maritime (11%) ecozones.

Table 1: Total number of farms by farm type, by ecozone

	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	All Ecozones
Dairy	880	220	1,200	635	13,860	1,800	4,845	23,435
Beef	1,085	2,380	17,735	13,375	14,575	3,945	3,940	57,035
Hog	195	0	1,770	760	2,945	220	700	6,590
Poultry and Egg	315	155	520	165	2,175	195	200	3,740
Livestock Combination	365	235	3,195	895	1,650	395	380	7,120
Grain and Oilseed	265	410	53,675	15,890	17,335	670	235	88,475
Potato	x	0	x	x	205	x	620	1,085
Tobacco	x	0	x	0	905	x	x	935
Fruit and Vegetable	780	1,415	380	x	3,840	335	1,200	7,975
Greenhouse and Nursery	630	225	600	x	1,515	360	x	3,630
Other Farm Types	1,260	1,385	4,385	3,560	7,530	1,765	4,160	24,040
All Farms	5,775	6,425	83,460	35,370	66,535	9,685	16,485	224,060

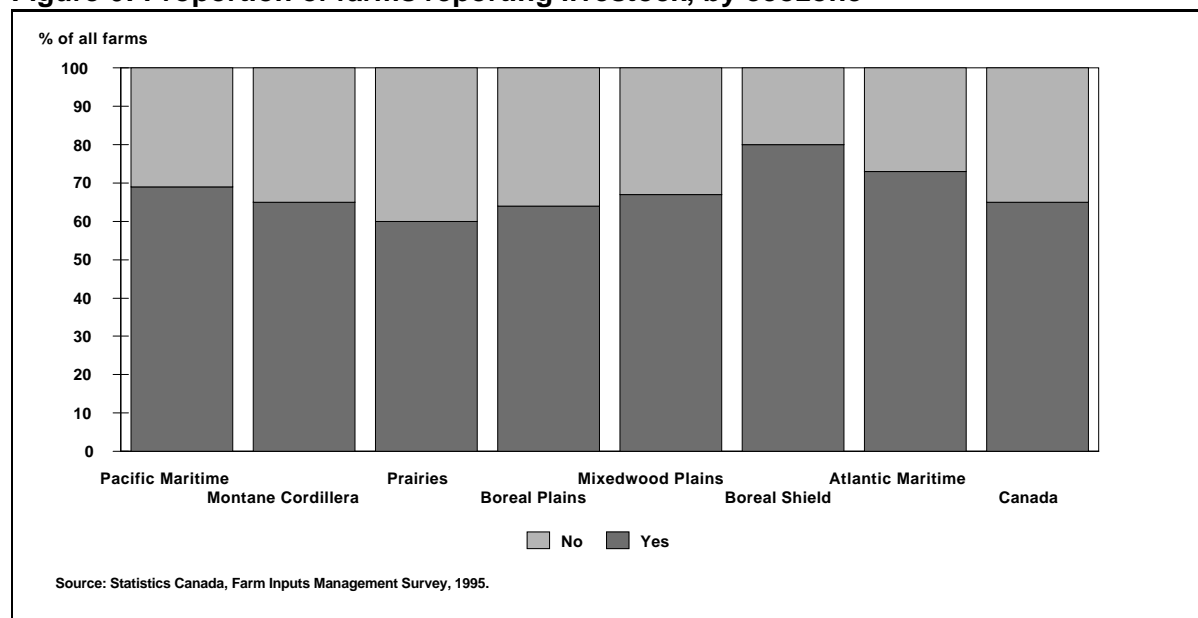
"x" indicates confidential data.

Source: Statistics Canada, Farm Inputs Management Survey, 1995.

The table above shows that 97,920 farms (44%) can be classified under the general heading of "livestock farm". However, a significant number of livestock are kept on farms that are predominantly non-livestock types. Almost two-thirds of all farms report some livestock, seen in Figure 6 on page 12. This may range from as little as one laying hen to as many as

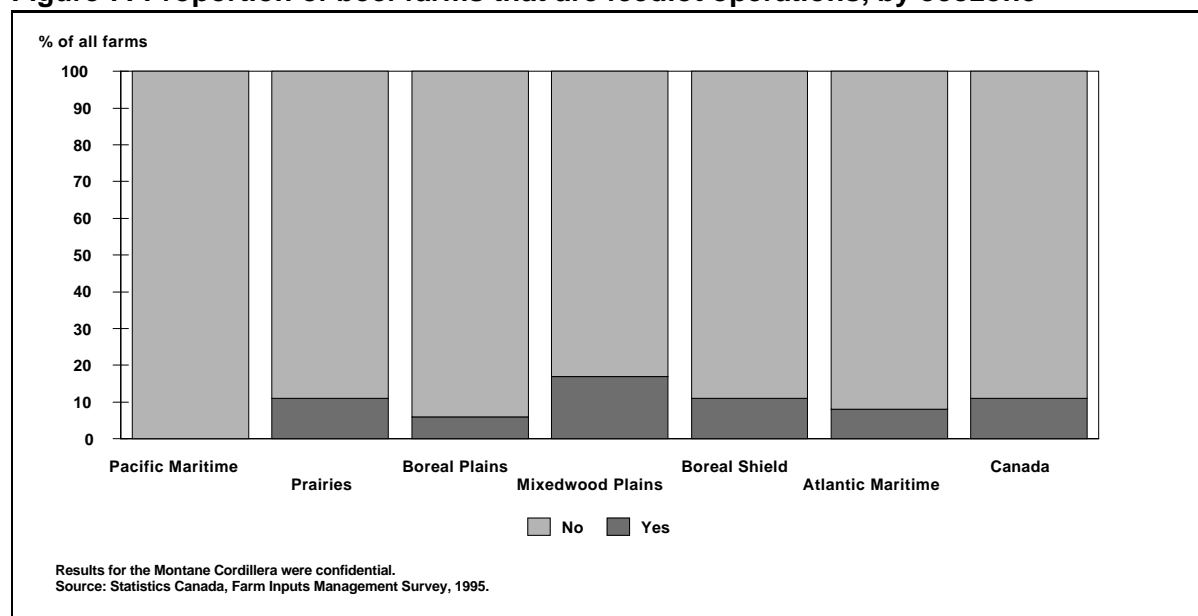
several thousand head of cattle. The large number of farms with livestock indicates that manure storage and disposal is a management issue on a large number of Canadian farms whether the farms produce livestock or crops.

Figure 6: Proportion of farms reporting livestock, by ecozone



The survey further breaks beef farms down into feedlot operations and other types of operations. The split can be seen in Figure 7. Feedlots are important from an environmental perspective because of the large concentration of cattle, and therefore manure, at one location. In most cases, there is not a high proportion of beef feedlots. Seventeen percent of the beef farms in the Mixedwood Plains are feedlot operations, the highest percentage among ecozones. This is particularly important given the large number of beef farms in the ecozone.

Figure 7: Proportion of beef farms that are feedlot operations, by ecozone



Distribution of Farms by Farm Revenue

Figure 8 shows the percentage of all farms classified by total farm revenue and by ecozone. Nationally, the first five revenue classes were very evenly distributed (17% to 20%) with a lower proportion for the highest revenue class (8%). Distribution of farms by revenue class varied by ecozone. The proportion of low revenue farms, those with less than \$10,000 in revenues, was highest in the Pacific Maritime (43%), the Montane Cordillera (37%) and the Boreal Shield (33%) ecozones. These ecozones represent the three smallest regions of Canadian agriculture. Conversely, the greatest proportion of farms in the highest revenue class, those with \$250,000 or more in revenues, were found in the Pacific Maritime (15%) and in the Mixedwood Plains (10%) ecozones.

Figure 8: Distribution of farms by revenue class, by ecozone

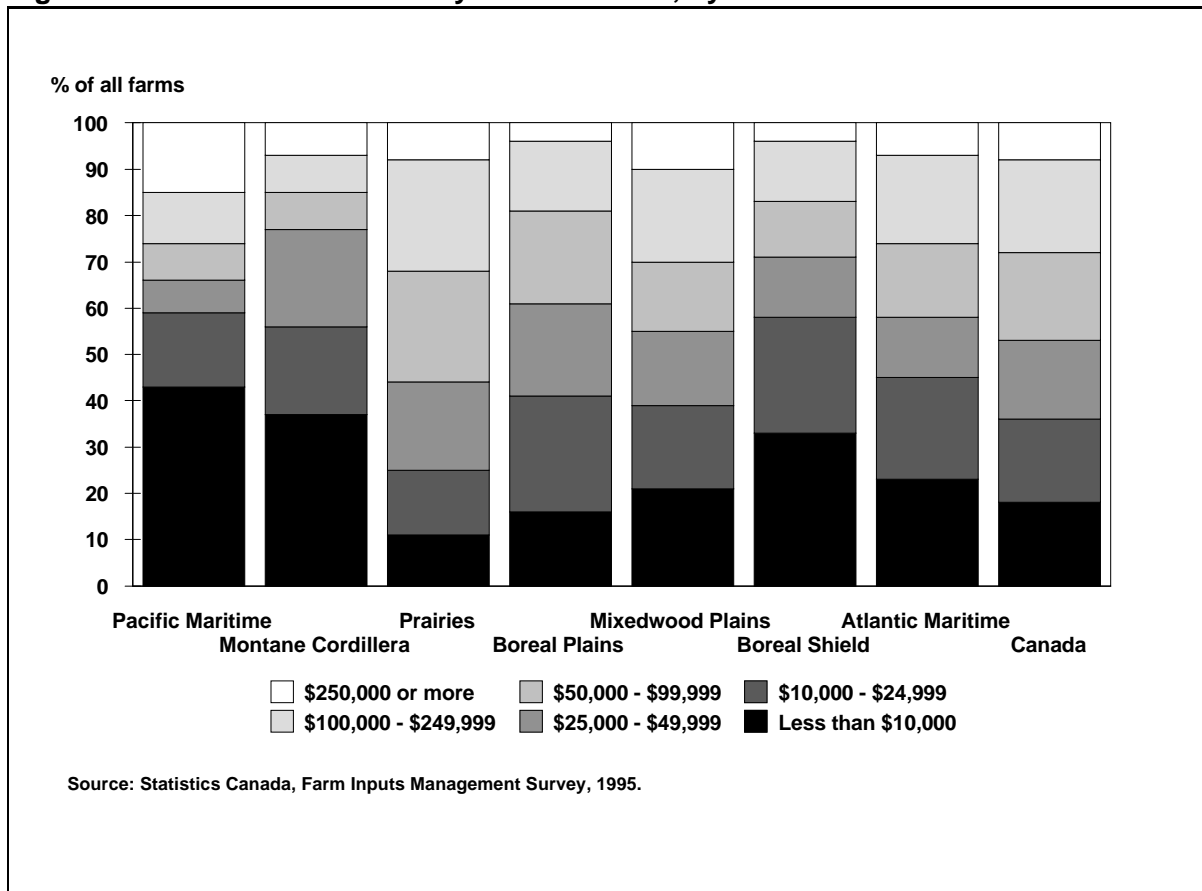


Table 2 on page 14 provides an estimate of the actual number of farms in each revenue class by ecozone. Though the Pacific Maritime ecozone has the highest proportion of small farms, the Mixedwood Plains has the largest number of them (13,915). The Mixedwood Plains also has the greatest number of the largest farms (6,875). The Prairies ecozone, which has the largest number of farms in total, has the greatest number of farming operations in each of the three mid-range revenue classes.

Table 2: Total number of farms by revenue class, by ecozone

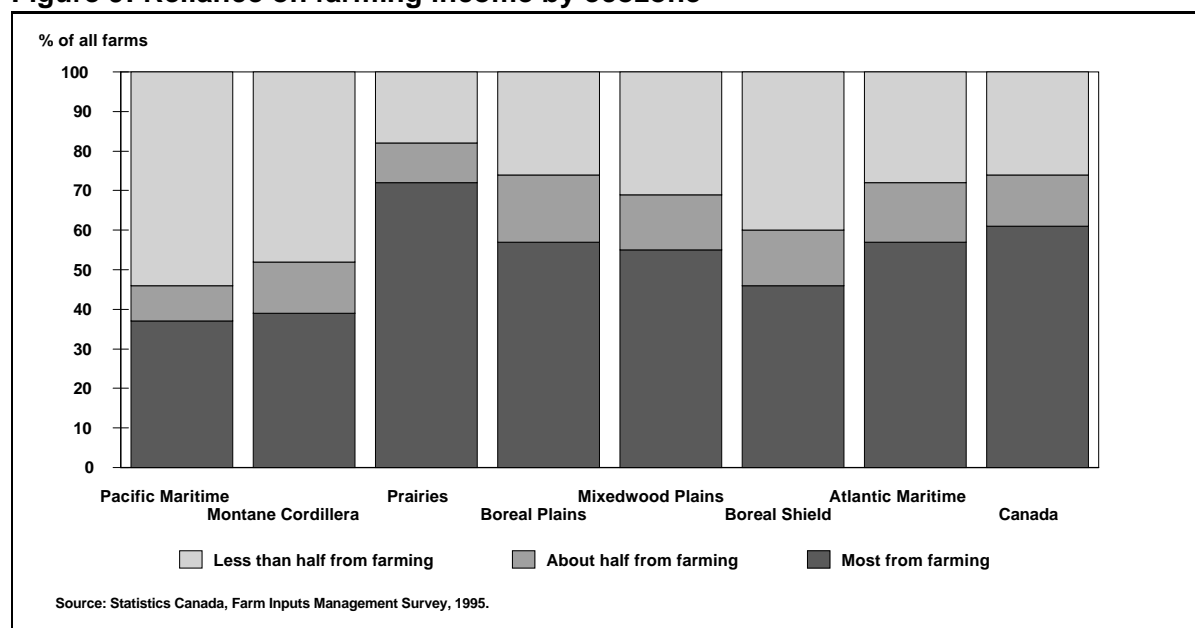
	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	All Ecozones
Less than \$10,000	2,530	2,340	9,035	5,785	13,915	3,255	3,770	40,625
\$10,000 - \$24,999	950	1,215	12,050	8,940	12,045	2,410	3,700	41,315
\$25,000 - \$49,999	420	1,370	15,755	6,925	10,515	1,260	2,095	38,335
\$50,000 - \$99,999	435	525	20,425	6,945	9,960	1,120	2,570	41,985
\$100,000 - \$249,999	630	540	19,795	5,380	13,230	1,240	3,115	43,930
\$250,000 or more	880	445	6,505	1,475	6,875	420	1,245	17,855
All Farms	5,845	6,435	83,565	35,450	66,540	9,705	16,495	224,045

Source: Statistics Canada, Farm Inputs Management Survey, 1995.

Distribution of Farms by Reliance on Farming Income

Figure 9 shows the breakdown of farm operations within each ecozone by the reliance on the farm business for income. Sixty-one percent of farmers rely on their farms for most of their income. In addition, 13% of farmers receive about equal levels of income from farm and off-farm sources. Farming income is therefore of significant importance to the majority of the farmers in the sample. Only 26% of farmers do not receive at least half of their income from farming. Most of these farmers operate small, often part-time farms. Though great in number, their contribution to total agricultural activity tends to be small.

Figure 9: Reliance on farming income by ecozone



Differences by ecozone reflect differences in the availability of agricultural resources, particularly land, and the availability of alternative off-farm income sources. On the Prairies, for example, with vast tracts of fertile agricultural land and a small number of metropolitan areas, 72% of farmers rely on farming for most of their income. Conversely, only 37% of Pacific Maritime farmers, concentrated in the small agriculture area of the Fraser Valley just outside the Vancouver suburbs, rely mostly on farming income. The two British Columbian ecozones, the Pacific Maritime and the Montane Cordillera, have the lowest proportion of farms that rely most on farm income. Conversely, more than half of the farms in each of these two ecozones rely predominantly on off-farm income sources.

Table 3 provides more detailed information by ecozone. The table shows that the agriculture sectors in the two ecozones in British Columbia, though relying on off-farm income, have only a small number of farms, most of which are considered part-time. On the other hand, the Prairies ecozone, which is shown to be a region of full-time farmers, has both the highest proportion and the highest number of farms relying most on income from farming.

Table 3: Distribution of farms by reliance on farming for income, by ecozone

	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	All Ecozones
Most income from farming	2,185	2,480	60,020	20,180	36,825	4,455	9,435	135,580
Half of income from farming	510	835	8,555	6,010	9,390	1,325	2,540	29,155
Most income from off-farm	3,150	3,115	14,995	9,270	20,330	3,915	4,525	59,320
All Farms	5,845	6,430	83,570	35,460	66,545	9,695	16,500	224,055

Source: Statistics Canada, Farm Inputs Management Survey, 1995.

Distribution of Farms by Operator Age

Table 4 on page 16 breaks down farm operations by age of operator and by ecozone. It is important to note that the age distribution relates to the operator that filled out the questionnaire and does not consider other operators. Nationally, 9% of farm operators are less than 35 years of age, 26% are 35 to 44, 26% are 45 to 54 and 39% are 55 or older. The Montane Cordillera has one of the lowest percentages of farm operators less than 35, the lowest percentage in the 35 to 44 age bracket and the highest percentage in the 55 or older age bracket.

Table 4: Distribution of farms by age of operator, by ecozone

	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	All Ecozones
Less than 35	130	195	8,085	3,150	6,050	830	1,745	20,185
35 - 44	2,000	1,355	23,095	8,005	17,230	2,810	4,425	58,930
45 - 54	1,530	1,670	20,925	9,560	17,730	2,500	4,475	58,395
55 or older	2,180	3,210	31,470	14,735	25,540	3,560	5,860	86,540
All Farms	5,840	6,430	83,575	35,450	66,550	9,700	16,505	224,050

Source: Statistics Canada, Farm Inputs Management Survey, 1995.

Distribution of Farms by Operator Education Level

Table 5 provides a breakdown of farm operations by level of education of the operator. Again, the results refer to the operator that completed the questionnaire. Nationally, 20% of farm operators have an elementary level of education or less, 50% have some secondary education and 30% have some post-secondary education. The Prairies, the Pacific Maritime and the Montane Cordillera have the smallest percentage of farm operators with an elementary level of education or less, while the Boreal Shield has the highest percentage of farm operators with this classification. Alternatively, the Pacific Maritime ecozone has the highest percentage of farm operators with some post-secondary education, a reflection of the large proportion of small and part-time operations. The Atlantic Maritime has the lowest percentage of farm operators with this classification.

Table 5: Distribution of farms by education level of operator, by ecozone

	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	All Ecozones
Elementary or less	790	890	12,420	7,195	15,930	2,635	4,045	43,915
Secondary	2,535	3,295	44,015	19,205	30,110	4,340	8,385	111,890
Some post- secondary	2,515	2,250	27,135	9,055	20,505	2,720	4,070	68,240
All Farms	5,840	6,435	83,570	35,455	66,545	9,695	16,500	224,045

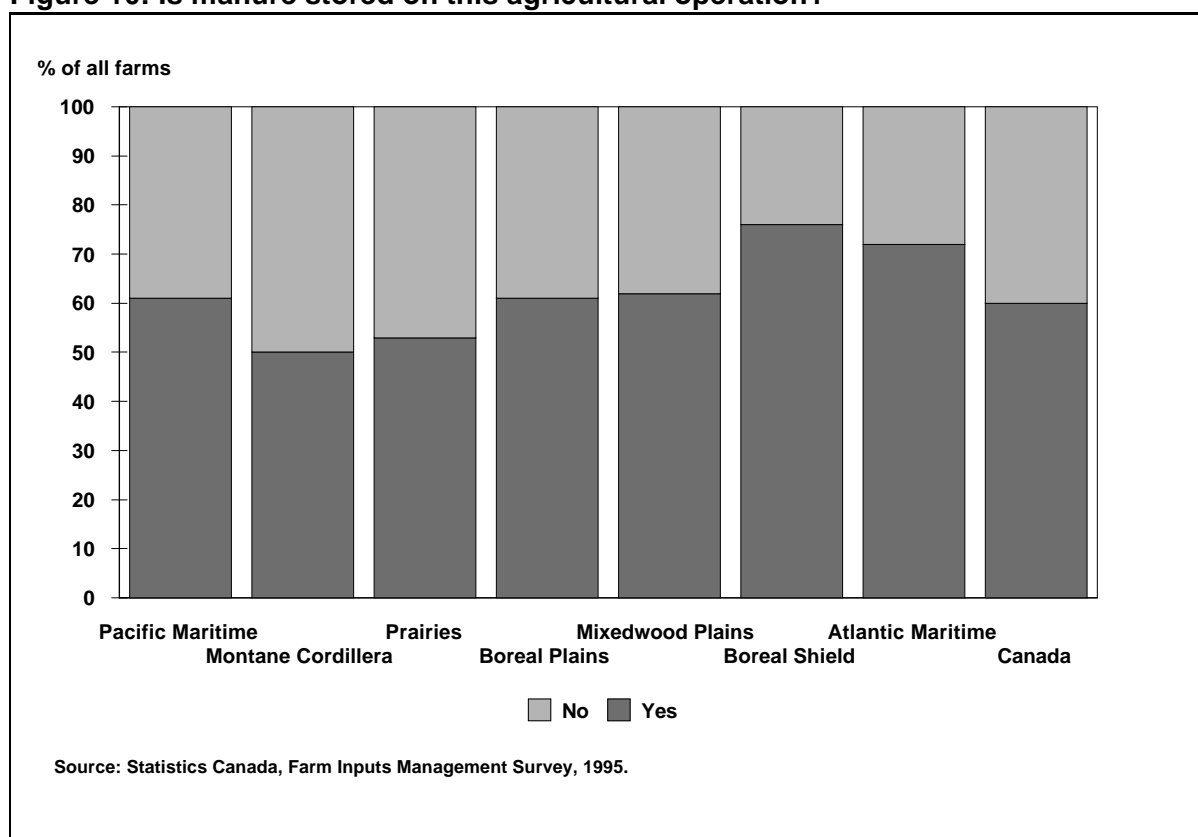
Source: Statistics Canada, Farm Inputs Management Survey, 1995.

Section 2: Manure Management

FIMS questions pertaining to manure management are directed at confined animal facilities. This is in contrast to large pasture areas and rangelands where animals are not confined and where there is less of an environmental risk. Issues pertaining to animals which are pastured with direct access to streams or other water bodies were not addressed in the survey.

The results from FIMS show that 60% of respondents (133,655 farms) reported that they stored manure on their agricultural operation in 1995. Figure 10 illustrates the breakdown of respondents reporting manure storage by ecozone. The Boreal Shield reported the highest percentage of respondents storing manure on their agricultural operation (76%) while the Montane Cordillera reported the lowest percentage of respondents storing manure on their agricultural operation (50%).

Figure 10: Is manure stored on this agricultural operation?



The number of survey respondents reporting that they stored manure varies by type of farm operation within each ecozone. Table 6 on page 18 presents a summary of farms by ecozone and farm type that reported storing manure. The estimates refer to the number of farms that store manure either as a liquid or in solid form.

Table 6: Number of farms storing manure, by farm type, by ecozone

Farm Type	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	All Ecozones
Dairy	880	x	1,080	570	13,575	1,790	4,835	22,950
Beef	790	1,725	15,210	12,405	12,660	3,585	3,830	50,200
Hog	x	x	1,770	705	2,945	220	680	6,505
Poultry and Egg	x	x	405	x	1,720	110	x	2,820
Livestock Combination	x	80	2,510	800	1,535	390	355	5,910
Grain and Oilseed	x	x	21,220	5,310	4,020	165	80	31,080
Potato	x	x	x	x	x	x	330	335
Fruit and Vegetable	165	280	x	x	665	145	265	1,530
Greenhouse and Nursery	x	x	x	x	x	x	x	340
Other Farm Types	815	650	2,385	1,560	4,145	980	1,380	11,915
All Farms	3,560	3,210	44,680	21,455	41,430	7,385	11,940	133,660

"x" indicates confidential data.

Results for tobacco farms were confidential.

Manure storage refers to both liquid and solid manure. Some farms have both liquid and solid manure storage.

Source: Statistics Canada, Farm Inputs Management Survey, 1995.

Liquid Manure Storage

About 11% (14,855) of Canadian farms that stored manure on their operations stored liquid manure. Dairy, hog and poultry and egg farms were the most likely operations to store liquid manure; hog farms, in particular, make use of this method. Figure 11 provides a breakdown by ecozone showing the proportion of farms reporting that they stored liquid manure. Farmers in the Boreal Plains reported the lowest percentage for liquid manure storage at 4%. The Boreal Shield and Atlantic Maritime closely followed the Canadian average with 12% and 13% of farm operations, respectively, reporting liquid manure storage. The highest percentage of farms reporting liquid manure storage was in the Pacific Maritime with 20% and the Mixedwood Plains with 19%, a reflection of the high proportion of dairy, hog and poultry and egg farms in these regions. For the Prairies, hog operations were the highest users of liquid manure facilities, accounting for half of the farms reporting liquid manure storage for the ecozone. Grain and oilseed operations accounted for about a third of the farms reporting liquid manure storage in the Prairies ecozone.

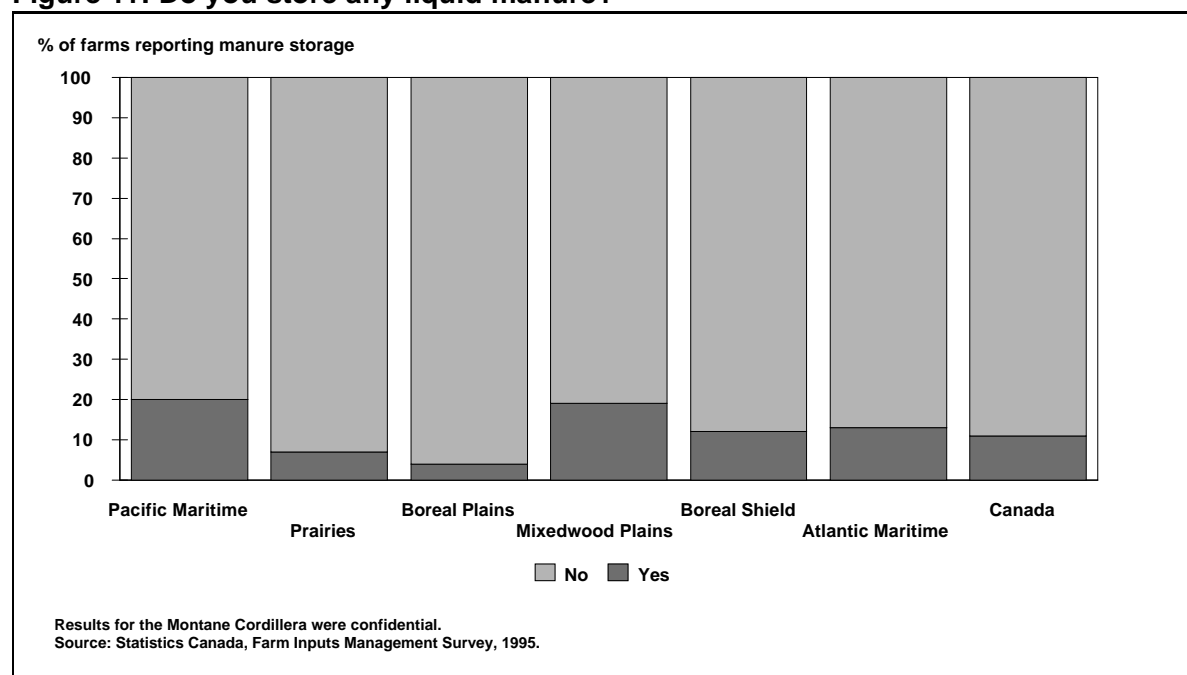
Figure 11: Do you store any liquid manure?

Table 7 contains the percentages of farms, by farm type and ecozone, that reported liquid manure storage. The majority of hog farms (81%) reported that they stored their manure in liquid form. Only poultry and egg farms (27%) and dairy farms (25%) also reported relatively high levels of liquid manure storage. Just 2% of beef farms reported that they stored liquid manure.

Table 7: Proportion of farms storing liquid manure, by farm type, by ecozone

Farm Type	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	All Ecozones
Dairy	66%	x	x	22%	25%	31%	16%	25%
Beef	x	0%	x	x	5%	0%	2%	2%
Hog	x	x	89%	73%	77%	100%	91%	81%
Poultry and Egg	x	x	x	x	36%	x	x	27%
Livestock Combination	x	0%	8%	0%	x	x	x	6%
Grain and Oilseed	x	x	4%	3%	13%	x	x	5%
Potato	x	x	x	x	x	x	0%	0%
Fruit and Vegetable	0%	0%	x	x	x	0%	0%	x
Other Farm Types	0%	0%	x	0%	x	x	x	2%
All Farms	20%	x	7%	4%	19%	12%	13%	11%

"x" indicates confidential data.

Results for tobacco farms and greenhouse and nursery farms were confidential.

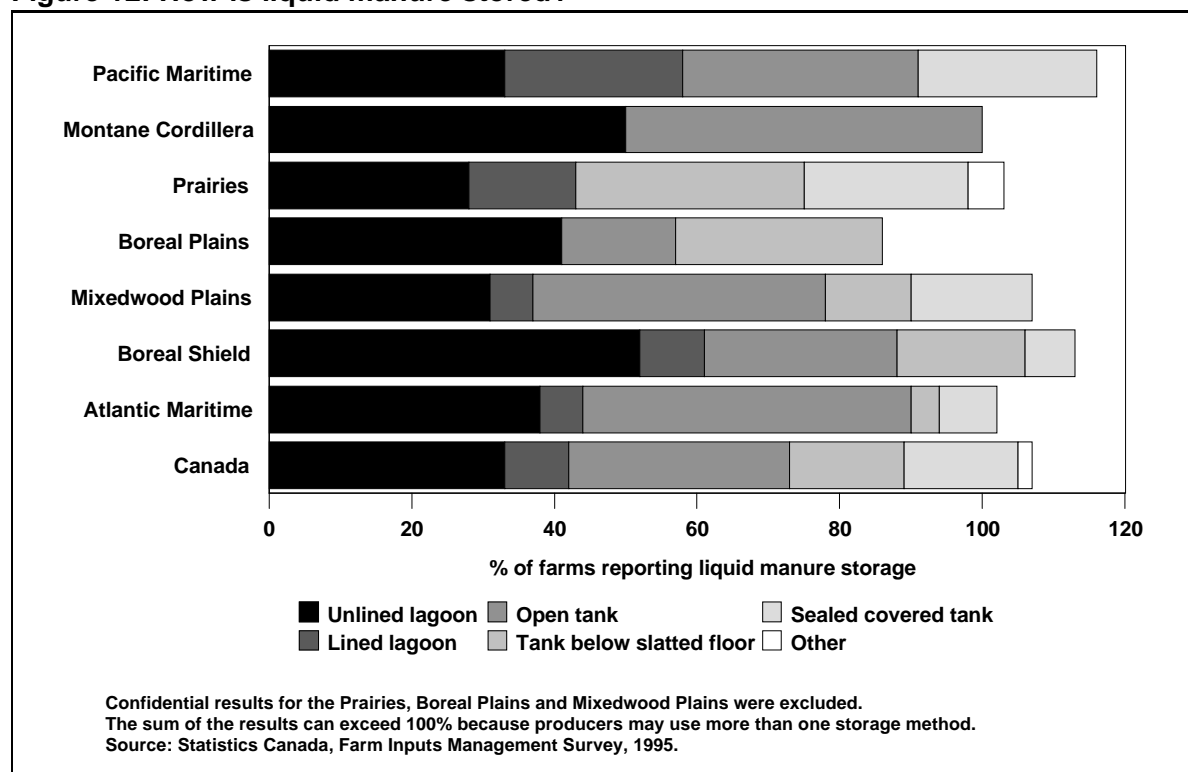
The numbers in the table refer to the percentage of farms with manure storage that report liquid manure storage. Some farms have both liquid and solid manure storage.

Source: Statistics Canada, Farm Inputs Management Survey, 1995.

Liquid Manure Storage Methods

Figure 12 summarizes the different liquid manure storage methods in each ecozone for farms reporting that they stored liquid manure in 1995. Of farms reporting that they stored liquid manure, the two most common methods of liquid manure storage in 1995 were unlined lagoons (33%) and open tanks (31%). Other liquid manure storage methods used included tank below slatted floor (16%), sealed covered tank (16%) and lined lagoon (9%). The remaining respondents used other methods of liquid storage.

Figure 12: How is liquid manure stored?



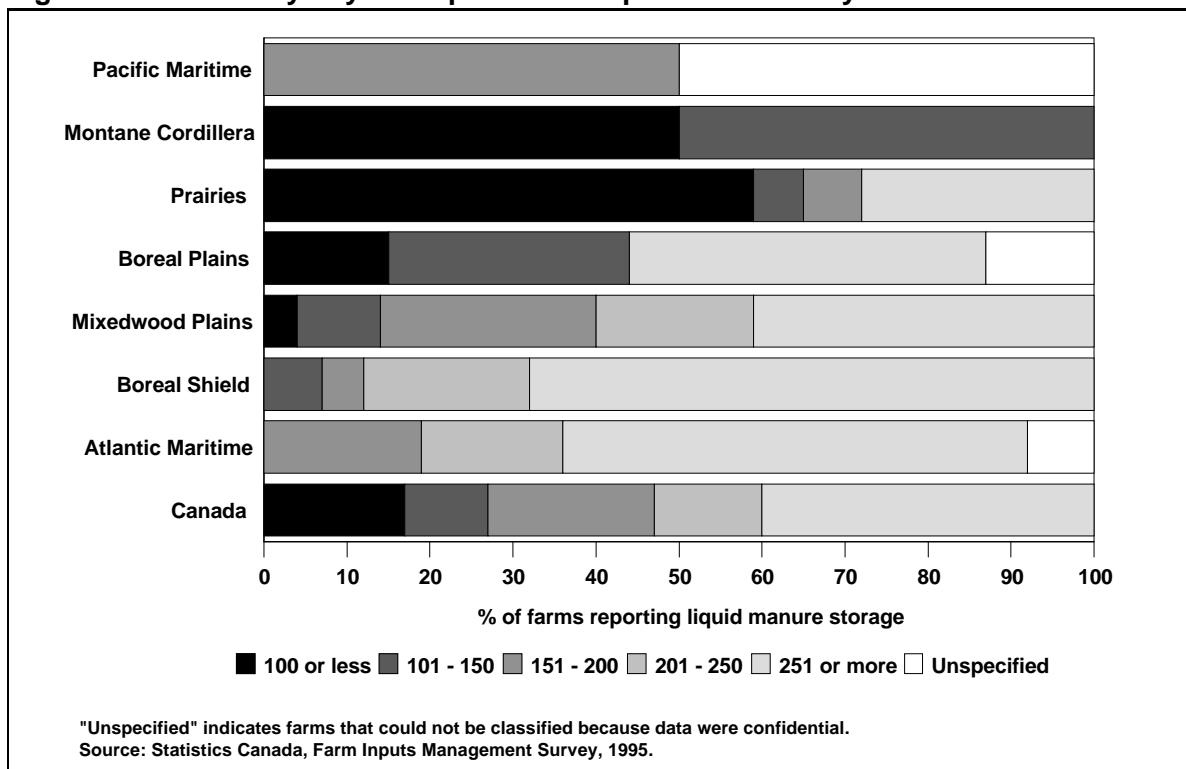
Liquid storage methods differed among regions. In the Atlantic Maritime, 46% of farms reporting liquid manure storage used open tanks and 38% used unlined lagoons. Tanks below slatted floors were not reported in this ecozone. In the Mixedwood Plains region, about 41% of farms used open tanks while 31% used unlined lagoons. In the Boreal Plains and the Prairies, 41% and 28% of respondents, respectively, reporting liquid manure storage used unlined lagoons and 29% and 32%, respectively, used tanks below slatted floors. Lined lagoons were not reported in the Boreal Plains and open tanks were not reported in the Prairies. In the Pacific Maritime, 33% of respondents reporting liquid manure storage used open tanks and 33% used unlined lagoons.

Liquid Manure Storage Capacity

Forty percent of producers that stored liquid manure (5,960 farms) reported liquid manure storage capacity that exceeded 250 days. The number of days of liquid manure storage by ecozone is shown in Figure 13. No farms in the Montane Cordillera reported the ability to store liquid manure for 251 days or more while the results for the Pacific Maritime were

confidential. Of the major agricultural ecozones, the Prairies reported the lowest percentage of farms (28%) with the ability to store liquid manure for 251 days or more. The Prairies also reported the largest percentage (59%) with the ability to store liquid manure for less than 101 days. Alternatively, all farms in the Boreal Shield reported having at least 101 or more days of liquid manure storage, as well as reporting the highest percentage (68%) of farm operations able to store liquid manure for 251 or more days. In general, ecozones with higher precipitation levels, extended periods of frozen ground and high livestock densities required greater liquid manure storage capacity.

Figure 13: How many days of liquid manure production can you store?



Distance from Water Sources

Of Canadian farms reporting that they stored liquid manure in 1995, 96% reported storing liquid manure more than 15 metres from the nearest watercourse. Likewise, 96% reported storing liquid manure more than 30 metres from any well used for domestic purposes. Figures 14 and 15 on page 22 show the distance of liquid manure facilities from the nearest watercourse and from the nearest well used for domestic purposes, respectively, by ecozone. Farmers were not actually given the respective 15-metre and 30-metre thresholds for these questions. They were simply asked for the distance. The interviewers were required to check the appropriate response box. This was done in an effort to remove bias by not associating the thresholds as being “safe” or “unsafe.”

In the Boreal Shield and Montane Cordillera ecozones, all surveyed farms maintained storage facilities a reasonable distance from both watercourses and wells. In addition, all surveyed farms in the Boreal Plains kept liquid storage facilities more than 15 metres from the nearest watercourse. Similarly, all surveyed farms in the Pacific Maritime kept liquid storage facilities more than 30 metres from domestic wells.

Figure 14: How far are the liquid manure storage facilities from the nearest watercourse?

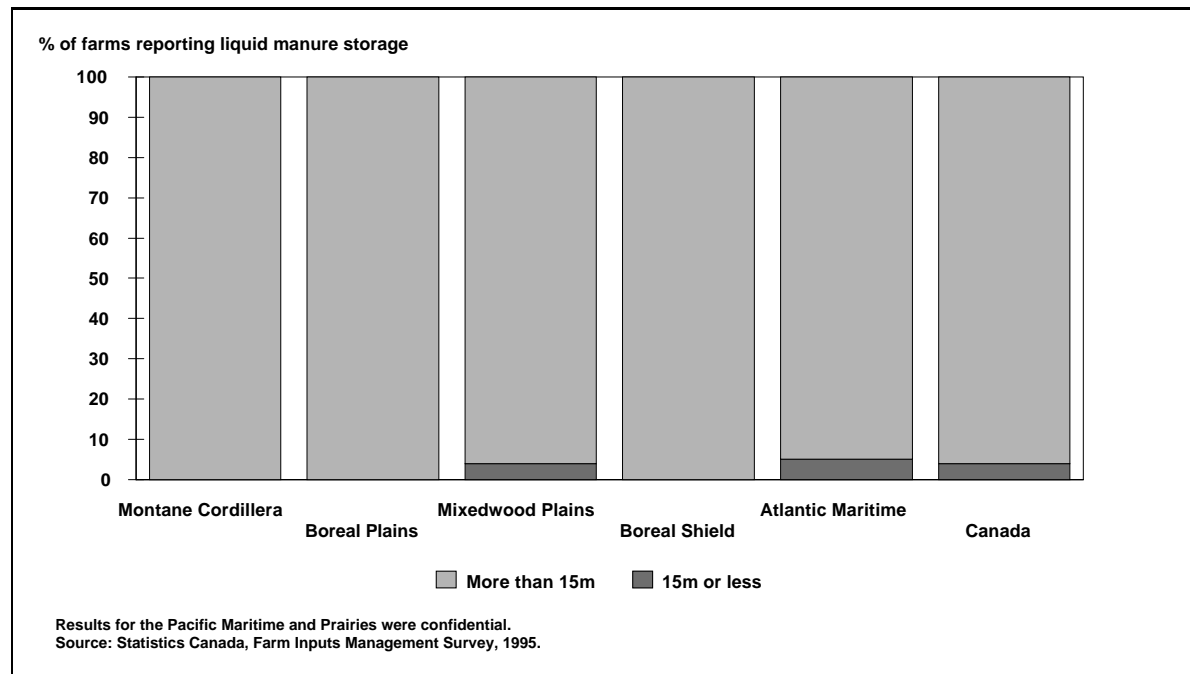
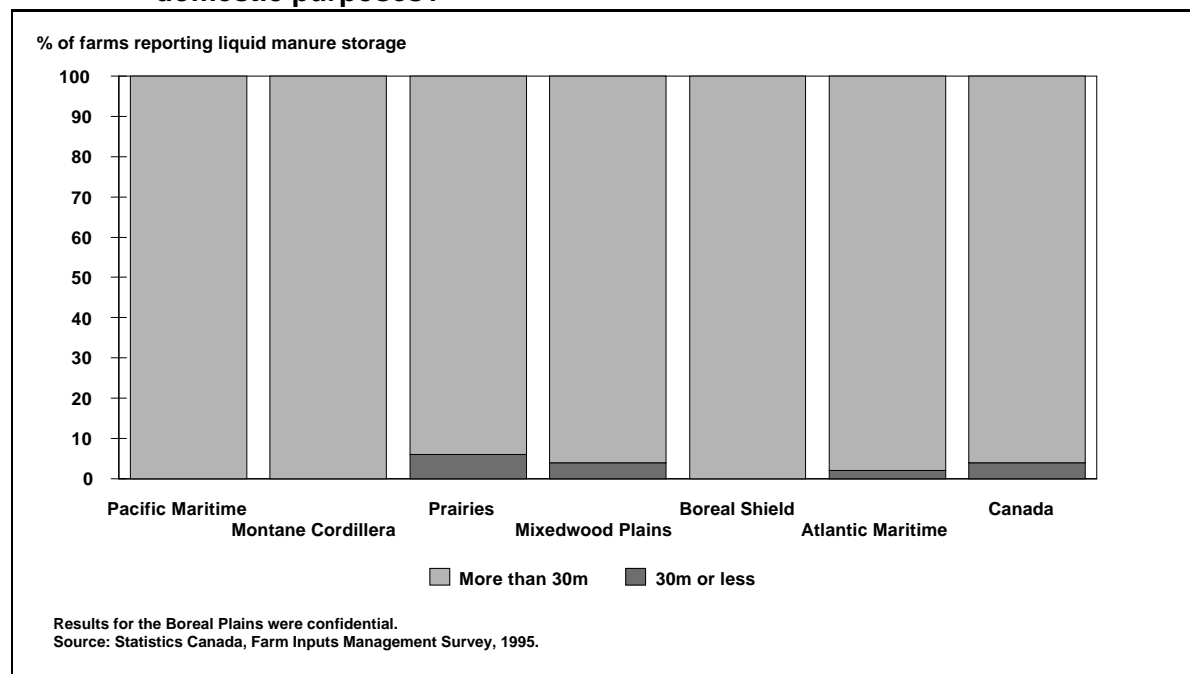


Figure 15: How far are the liquid manure storage facilities from any well used for domestic purposes?



It is important to note that these specific results are based on a sample survey and are therefore subject to sampling error. It is highly likely that at least some farms in each of the Boreal Plains and the Boreal Shield keep liquid storage facilities less than 15 metres from the nearest watercourse. The same can be assumed for farms in the Pacific Maritime and Boreal Shield with respect to domestic wells.

As noted in the introduction, results for these two questions should be used with some caution. It is suspected that the telephone interview technique, which was used to collect the survey data, encouraged an underestimate of the true number of liquid manure storage facilities within the specified safe distances.

Solid Manure Storage

Of Canadian farms storing manure on their farm operations, approximately 95% (126,470 farms) stored solid manure. Solid manure storage was more commonly used than liquid storage and survey results indicated that farms with liquid manure storage also used solid manure storage. Farm operations utilizing solid manure storage varied by farm type and ecozone. Figure 16 compares the proportion of solid manure storage by ecozone.

Figure 16: Do you store any solid manure?

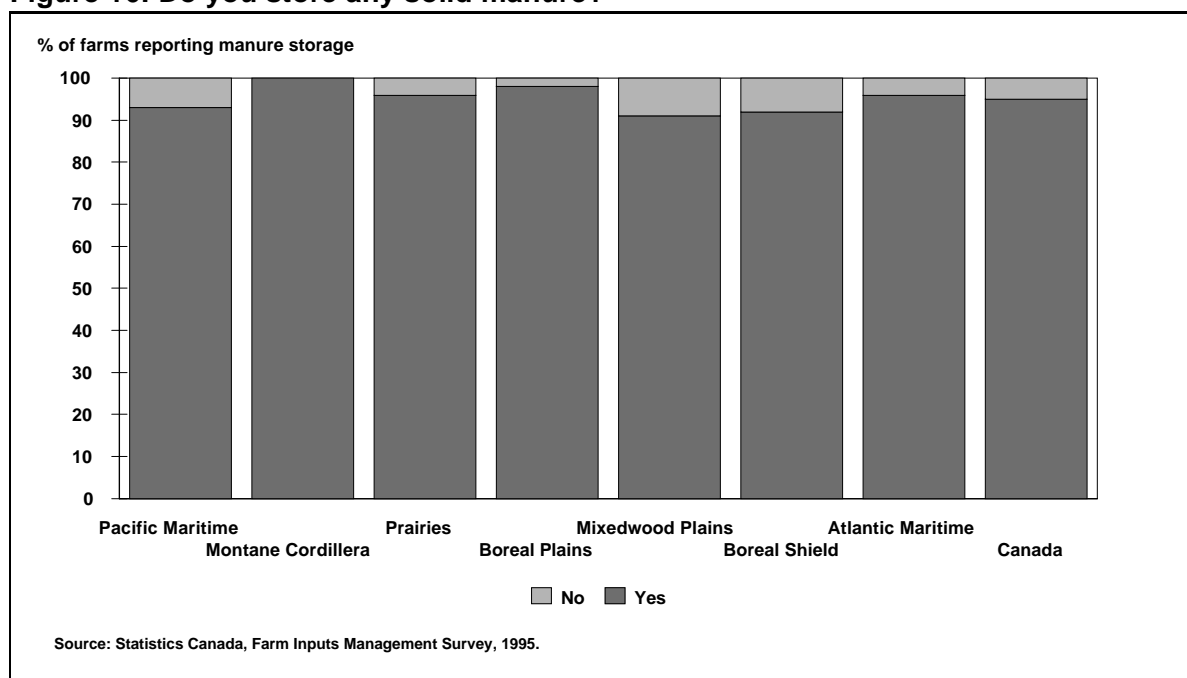


Table 8 on page 24 provides greater detail about solid manure storage by ecozone and by farm type. The Mixedwood Plains reported the lowest percentage of solid manure storage, it being used on 91% of farms storing manure. The Boreal Shield and the Pacific Maritime ecozones had lower than average levels of solid manure storage because their dairy and hog sectors reported greater use of liquid manure storage. In the Atlantic Maritime and the Prairies, the incidence of solid manure storage was slightly above the national average. However, in the Prairies, hog operations stood out with only 39% reporting solid manure storage. Farms in the Boreal Plains and the Montane Cordillera reported a higher than average proportion of solid manure storage at 98% and 100%, respectively, for two primary

reasons: dairy operations in both ecozones had a high percentage of solid manure disposal, and; hog operations in the Boreal Plains had a higher percentage of solid manure storage than the national average.

Overall, hog operations at 50% stored the lowest percentage of solid manure, generally making greater use of liquid storage (81%). However, beef, livestock combination, grain and oilseed and “other types” operations reported using almost exclusively solid manure storage. All beef farms (100%) and most livestock combination farms (99%) reported that they stored their manure in solid form. As well, 88% of all poultry and egg and 90% of all dairy operations reported solid manure storage despite significant use of liquid storage. Virtually all crop-type farms that had manure storage reported solid manure storage.

Table 8: Proportion of farms storing solid manure, by farm type, by ecozone

Farm Type	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	All Ecozones
Dairy	73%	x	100%	98%	88%	83%	97%	90%
Beef	100%	100%	100%	100%	99%	100%	99%	100%
Hog	x	x	39%	67%	50%	x	67%	50%
Poultry and Egg	x	x	86%	x	84%	93%	x	88%
Livestock Combination	x	100%	100%	100%	100%	85%	100%	99%
Grain and Oilseed	x	x	98%	97%	94%	98%	67%	97%
Potato	x	x	x	x	x	x	100%	100%
Fruit and Vegetable	100%	100%	x	x	100%	100%	100%	100%
Greenhouse and Nursery	x	x	x	x	x	x	x	100%
Other Farm Types	100%	100%	100%	100%	100%	100%	100%	100%
All Farms	93%	100%	96%	98%	91%	92%	96%	95%

“x” indicates confidential data.

Results for tobacco farms were confidential.

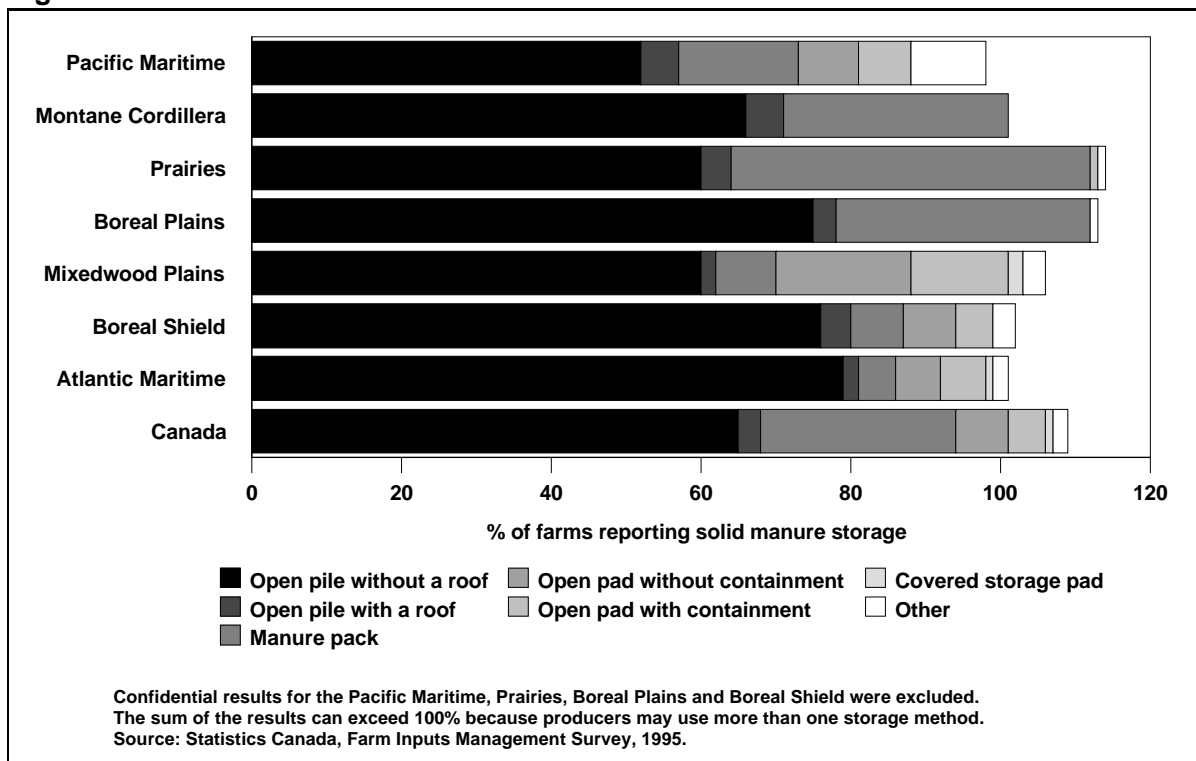
The numbers in the table refer to the percentage of farms with manure storage that report solid manure storage. Some farms have both liquid and solid manure storage.

Source: Statistics Canada, Farm Inputs Management Survey, 1995.

Solid Manure Storage Methods

Overall, the most popular method of storing solid manure was in an open pile without a roof. Approximately 60% of Canadian farms reporting solid manure storage reported this method of storage. The alternative storage methods varied considerably across ecozones, as shown in Figure 17. In the Prairies, Boreal Plains, Montane Cordillera and Pacific Maritime ecozones, respondents listed manure pack as the second most common choice at 48%, 34%, 30% and 16%, respectively. Note that survey respondents were able to report more than one storage method.

Figure 17: How is solid manure stored?



Distance from Water Sources

Figure 18 on page 26 indicates the number of farms with solid manure storage facilities a safe distance from the nearest watercourse. Figure 19 indicates the number of farms with solid manure storage facilities a safe distance from the nearest well used for domestic purposes. Of Canadian farms storing solid manure, 1% stored manure 15 metres or less from the nearest watercourse. Approximately 3% of respondents reported storing solid manure 30 metres or less from a well used for domestic purposes.

As with the corresponding section on liquid manure, the data in this section should be used with caution because of sampling error and the telephone interview method of data collection. Both can result in an underestimation of the number of farms that have manure storage facilities too close to water sources.

Figure 18: How far are the solid manure storage facilities from the nearest watercourse?

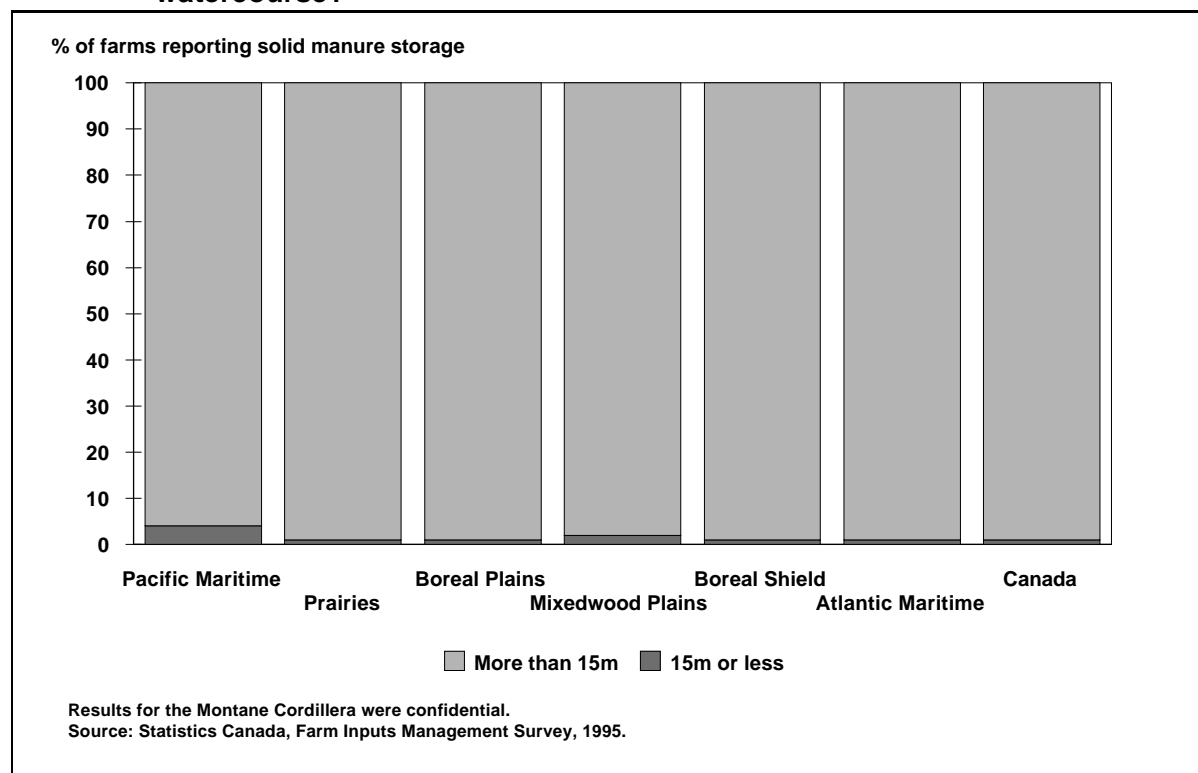
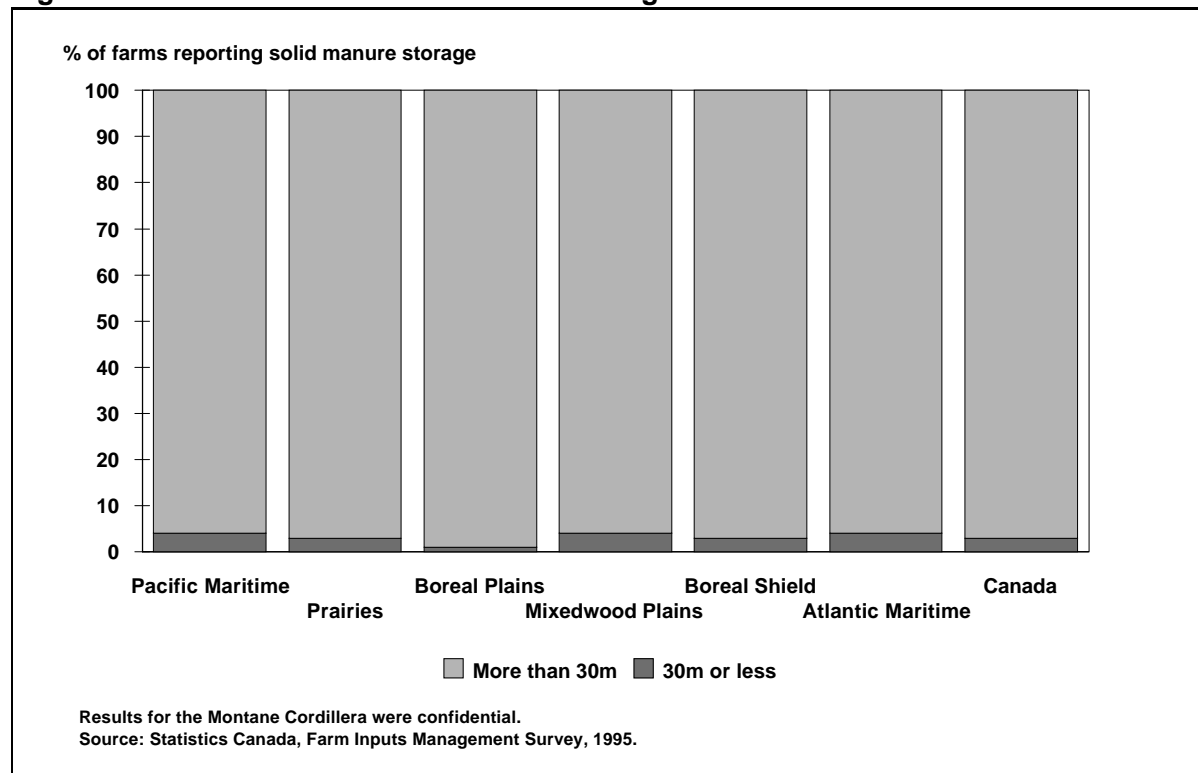


Figure 19: How far are the solid manure storage facilities from the nearest well?



Timing of Manure Application

The next two graphs, Figures 20 and 21, examine the timing of manure application to crop land for farms that reported manure application. Ideally, manure should be applied when the soil is dry enough and crop conditions are suitable for manure use. Twenty-three percent of Canadian farm operators reported applying manure during the winter. However, the amount of manure applied during this season was only 4% of the total amount of manure applied. The alternative application periods varied considerably across ecozones as shown in the figures. In the Pacific Maritime, Boreal Plains, Montane Cordillera and Prairies, 45%, 37%, 29% and 25% of respondents, respectively, reported applying manure during the previous winter. The reported percentage of total manure applied to fields in the winter in these ecozones were higher than average at 8%, 5%, 6% and 5%, respectively.

Figure 20: Of the farms that applied manure in 1995, what percentage applied manure in the winter, in the spring, in the summer and in the fall?

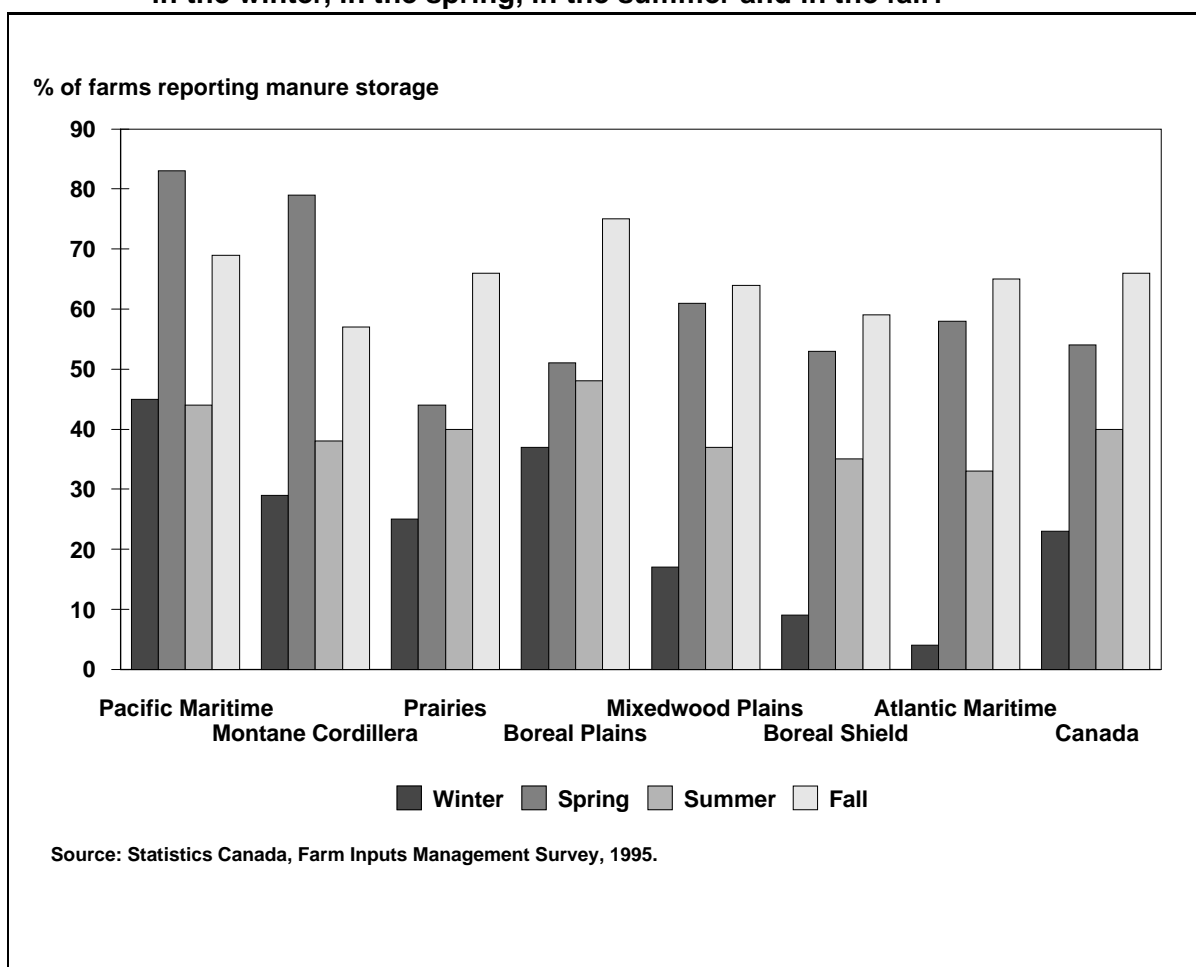
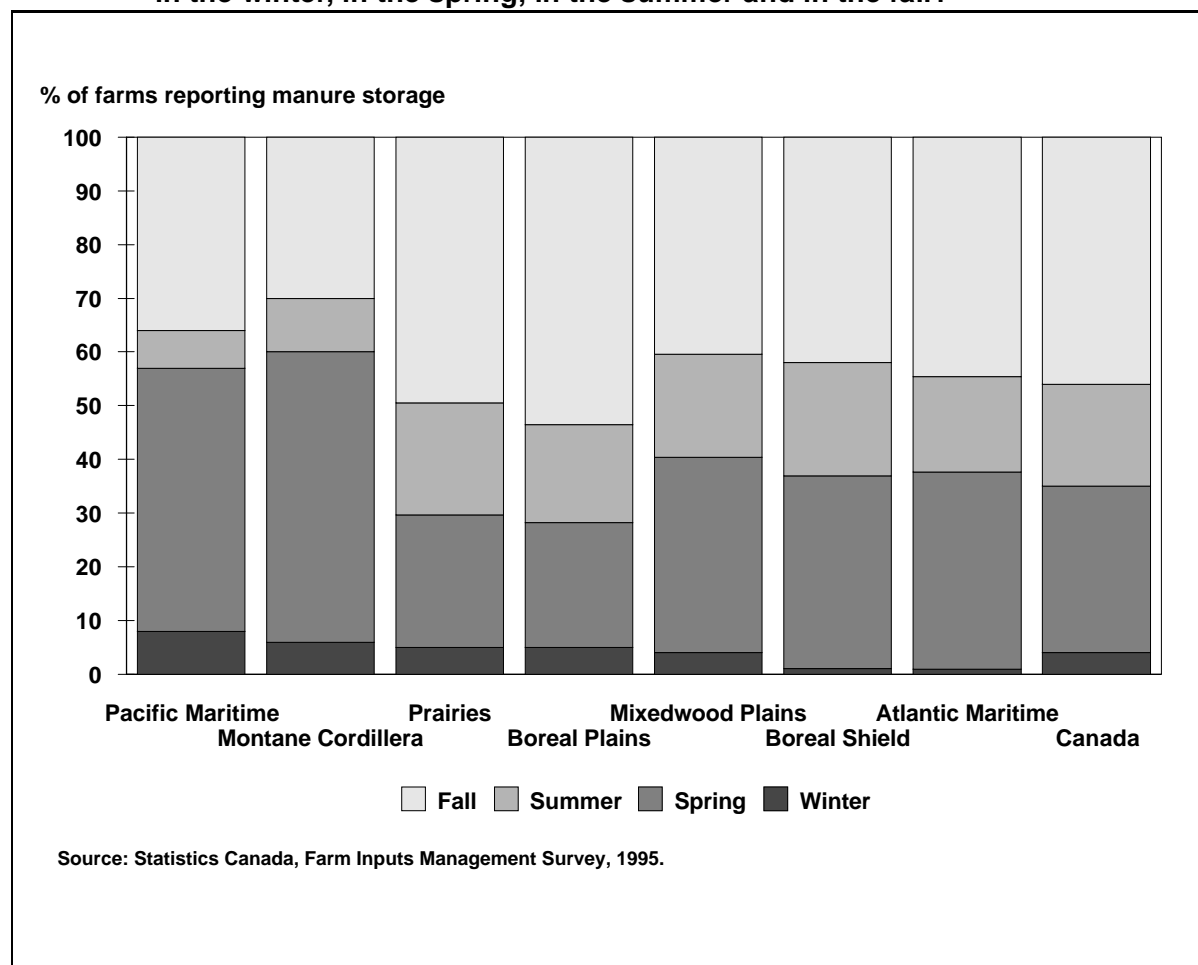


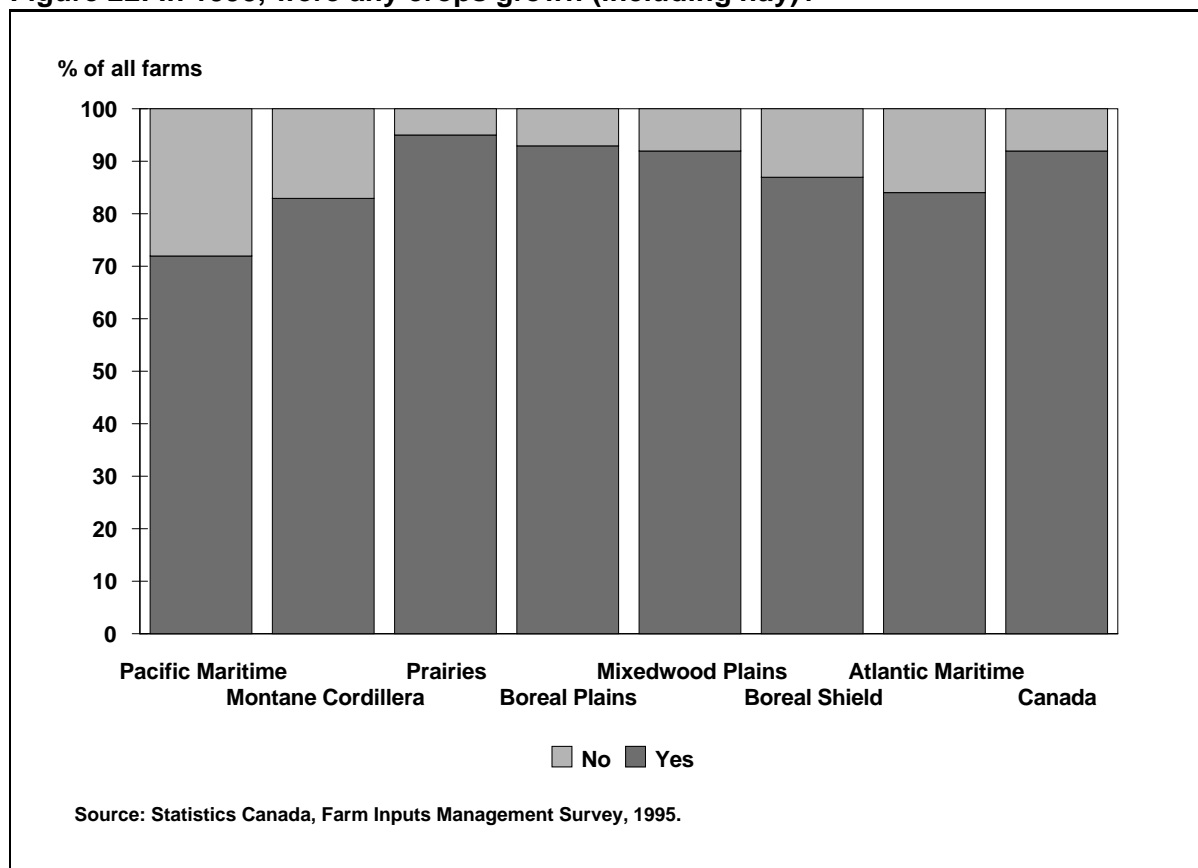
Figure 21: Of the total amount of manure applied in 1995, what percentage was applied in the winter, in the spring, in the summer and in the fall?



Section 3: Commercial Fertilizer Management

The results of FIMS show that in 1995 approximately 92% of farms (206,000 farms) reported that they grew crops, including hay¹. Figure 22 illustrates the breakdown of farms at the ecozone level.

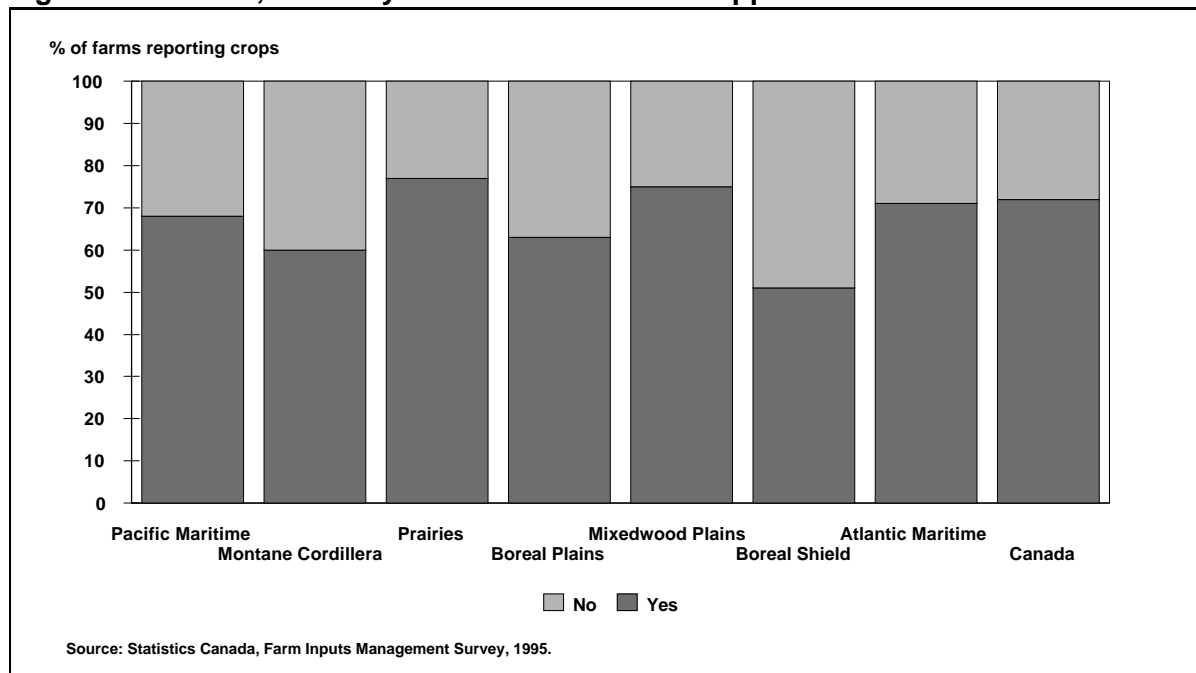
Figure 22: In 1995, were any crops grown (including hay)?



Of Canadian farm operations that grew crops in 1995, 72% of the producers (148,055 farms) reported using commercial fertilizers that year. The proportion of farm operations that applied commercial fertilizers varied by ecozone as illustrated in Figure 23 on page 30. The Prairies and the Mixedwood Plains reported the highest percentages using commercial fertilizers at 77% and 75%, respectively. The Boreal Shield reported the lowest percentage of farm operations applying commercial fertilizers at 51%.

1. FIMS results for fertilizer and pesticide management are calculated on the basis of farms that reported either crops or hay.

Figure 23: In 1995, were any commercial fertilizers applied?



Fertilizer Application

Figure 24 shows the alternate methods of applying fertilizer for farms reporting that they used commercial fertilizer in 1995. Broadcasting was the most frequently-used method of applying commercial fertilizer in all ecozones except the Boreal Plains and the Prairies. Fertilizer was applied most frequently with the seed in these two ecozones. Note that respondents were able to report more than one method of fertilizer application.

Figure 24: In 1995, how was commercial fertilizer applied?

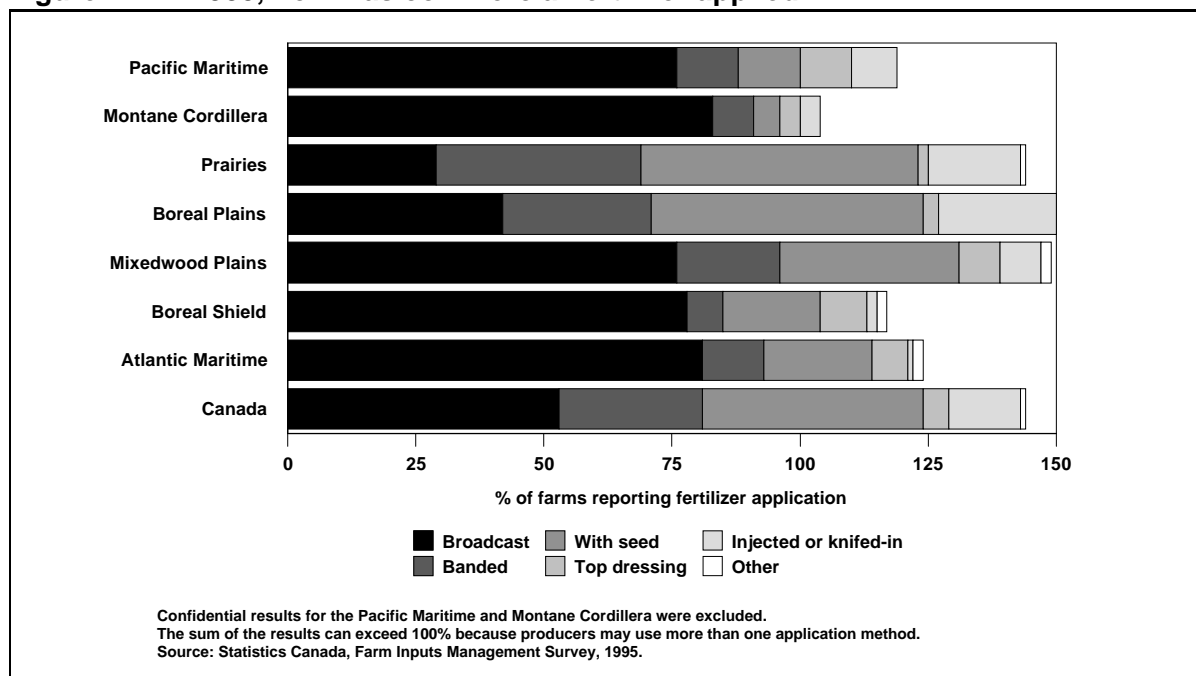
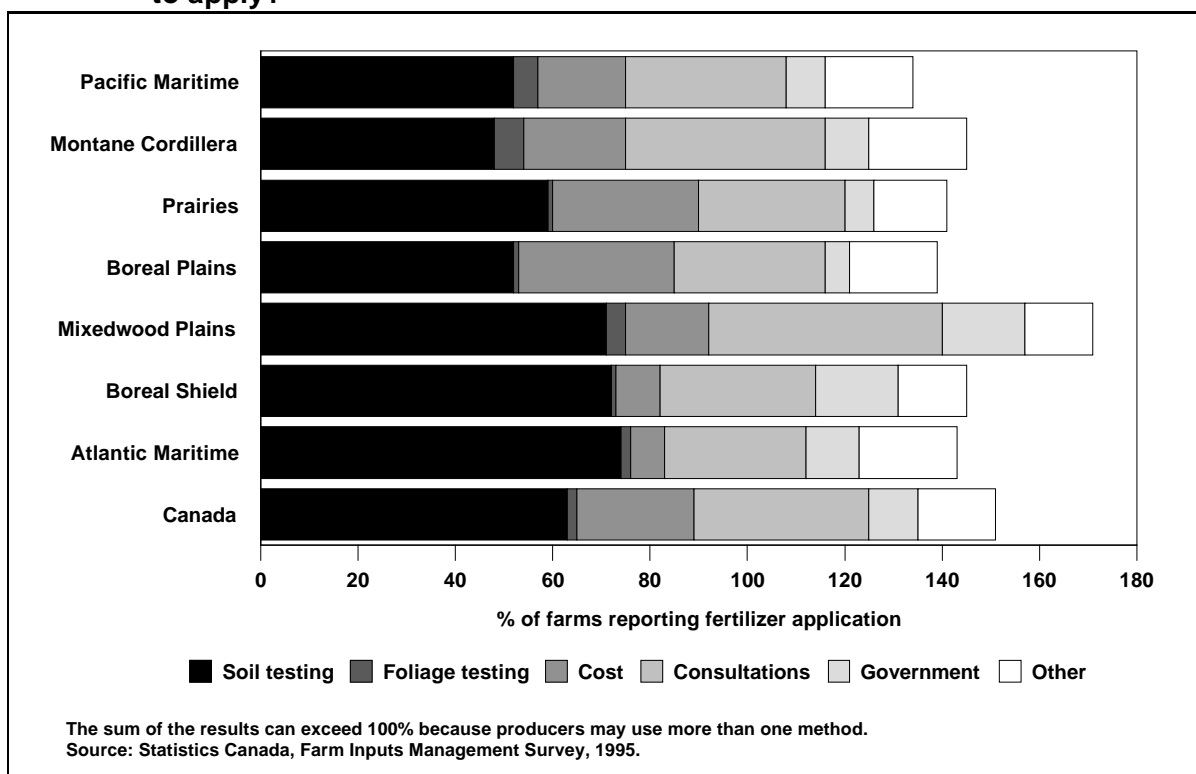


Figure 25 lists the methods used to decide on the amount and type of commercial fertilizer to apply for farms reporting that they used commercial fertilizer in 1995. For each ecozone, the majority of farm operators used soil testing to determine the amount and type of commercial fertilizer to apply. The second most popular method was consultation. An exception occurred in the Boreal Plains and the Prairies where both consultations and costs were reported as equally important.¹

Figure 25: How do you usually decide on the amount and type of commercial fertilizer to apply?

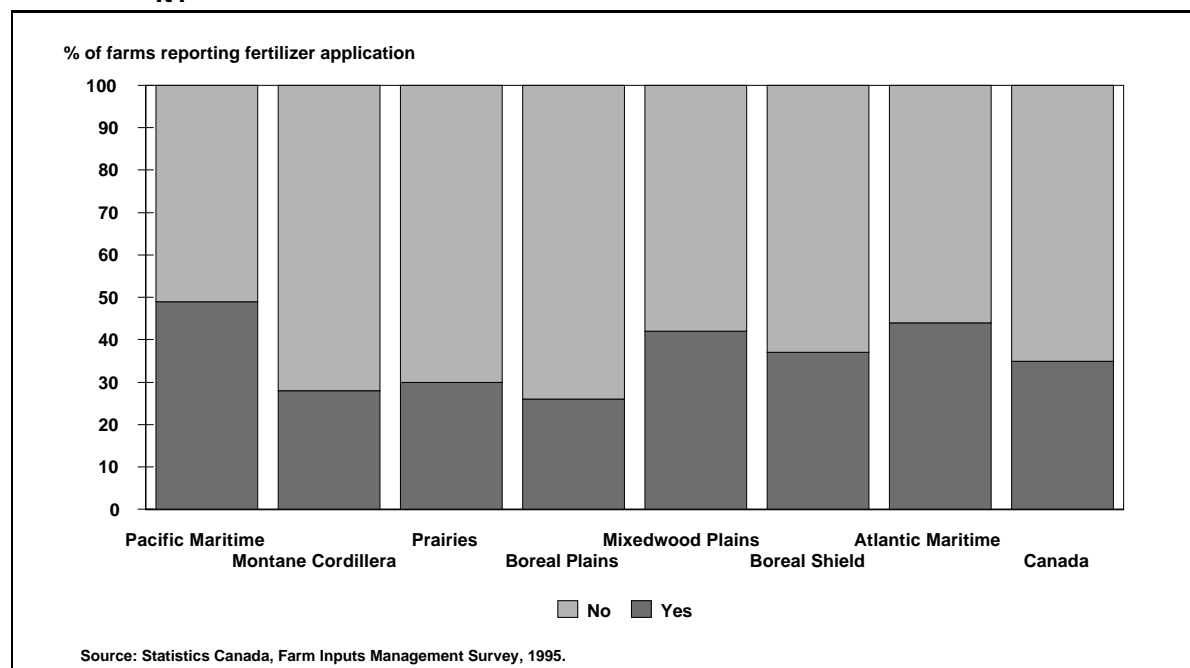


Fertilizer and Manure Management

The proportion of farm operations that reported having applied fertilizer to land that has manure applied to it is illustrated by ecozone in Figure 26 on page 32. Of Canadian farm operations that applied manure to their crop land in 1995, 35% of the farms (51,155 farms) also applied fertilizer to the land. The Pacific Maritime reported the highest proportion of farms (49%) that applied fertilizer to crop land that had also received manure. The Atlantic Maritime and the Mixedwood Plains reported 44% and 42%, respectively. The Boreal Plains reported the lowest percentage of farms applying fertilizer to land that also had manure applied to it, only 26%.

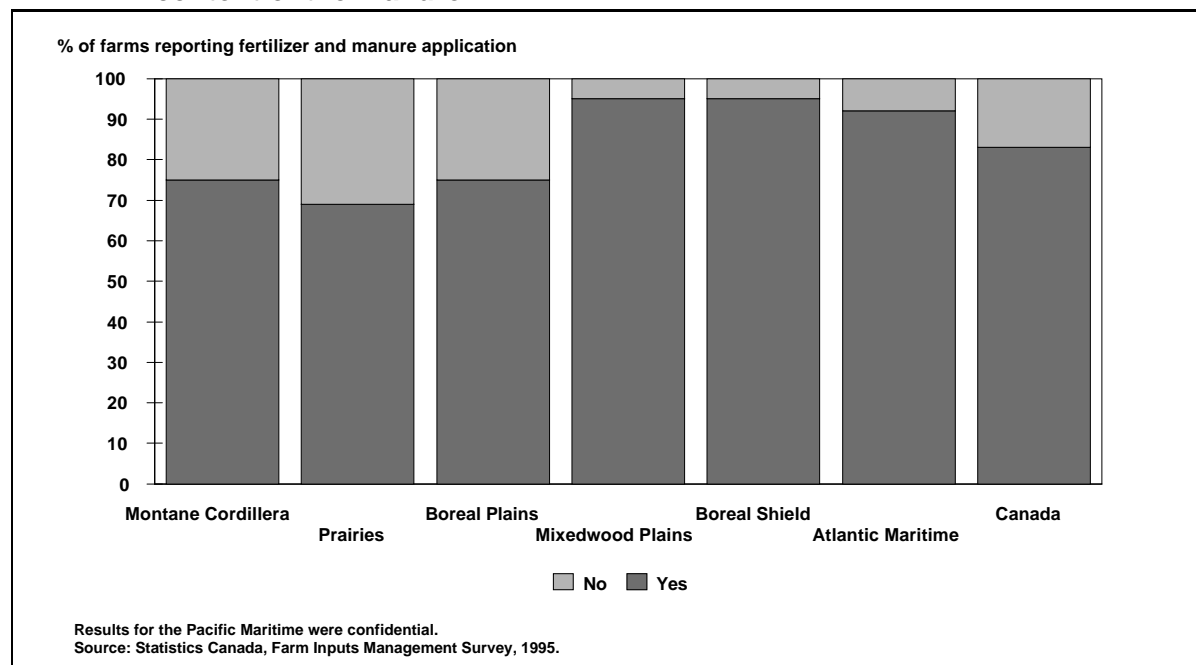
1. The survey did not address farms that decided not to apply fertilizer after soil testing.

Figure 26: Do you apply commercial fertilizers to land that has had manure applied to it?



As seen in Figure 27, of farms that applied both commercial fertilizers and manure to their land, approximately 83% (42,385 farms) reduced the amount of commercial fertilizer to offset the nutrient content of the manure. The Prairies reported the lowest percentage of farm operators that reduced the amount of commercial fertilizer applied to offset the manure at 69%. The Boreal Shield and the Mixedwood Plains reported the highest percentages of farm operators reducing fertilizer applications with 95% each.

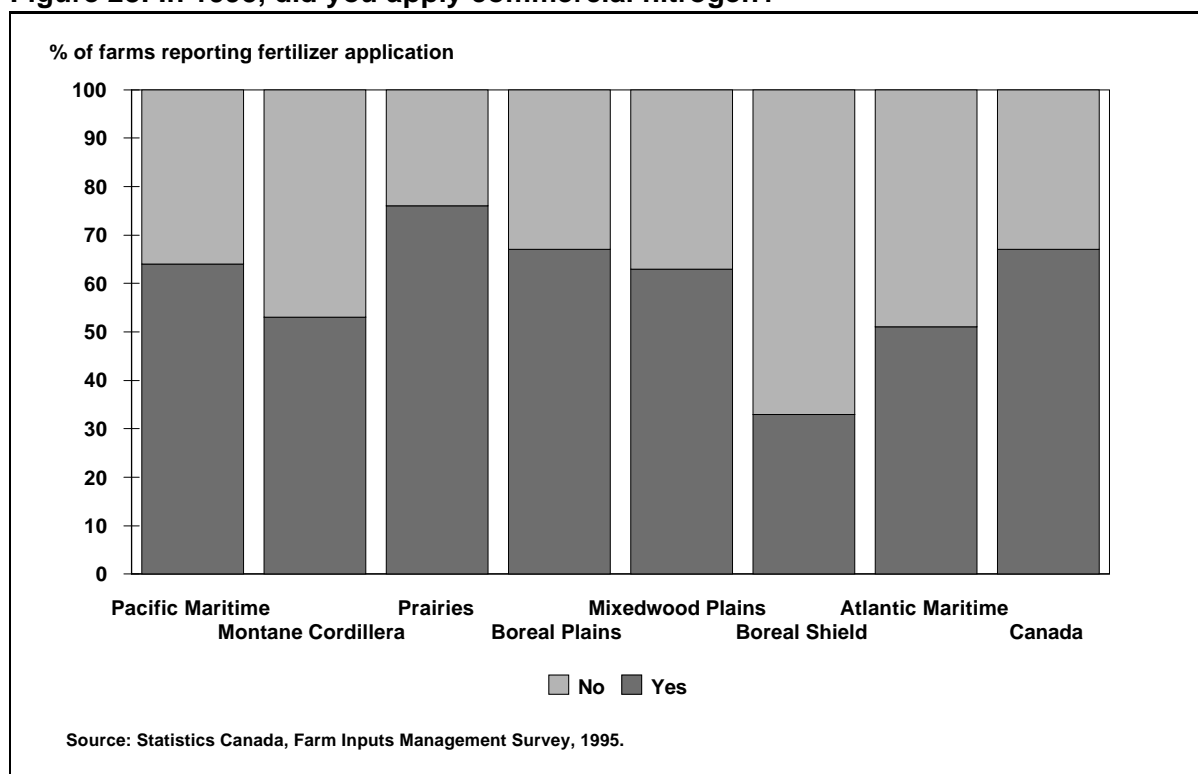
Figure 27: Do you reduce the amount of commercial fertilizer to offset the nutrient content of the manure?



Nitrogen Fertilizer

Of farms that applied commercial fertilizers, 67% (99,110 farms) reported that they applied commercial nitrogen in 1995, seen in Figure 28. The Prairies ecozone reported the highest percentage of farms that applied commercial nitrogen at 76%.

Figure 28: In 1995, did you apply commercial nitrogen?



The timing of application is important because of the potential danger of nutrient runoff. From environmental and economic perspectives, the primary concern is to reduce the runoff losses. Nitrogen fertilizer should be applied when it can be used most effectively by the young plant. The next two figures look at the timing of nitrogen fertilizer application.

Figure 29 on page 34 indicates that respondents from the Prairies and the Boreal Plains reported the highest proportion of farms applying nitrogen before planting at 72% each and the lowest proportion of farms applying nitrogen after planting at 8% and 12%, respectively. While the first figure indicates the number of farms reporting nitrogen application, Figure 30 adds information about the quantity of nitrogen fertilizer applied at various times during planting. Of Canadian farms that “applied commercial nitrogen before planting in 1995,” approximately 62% of farms reported applying on average 85% of the total amount of nitrogen. Of Canadian farms that “applied commercial nitrogen at planting,” approximately 42% of farms reported applying on average 66% of the total amount of nitrogen. Of Canadian farms that “applied commercial nitrogen after planting,” approximately 25% of farms reported applying an average of 77% of the total amount of nitrogen. Note that results in Figure 29 exceed 100% because farms can apply nitrogen fertilizer several times during the planting season.

Figure 29: Of the total amount of nitrogen applied in 1995, what percentage of respondents applied nitrogen before planting, at planting and after planting?

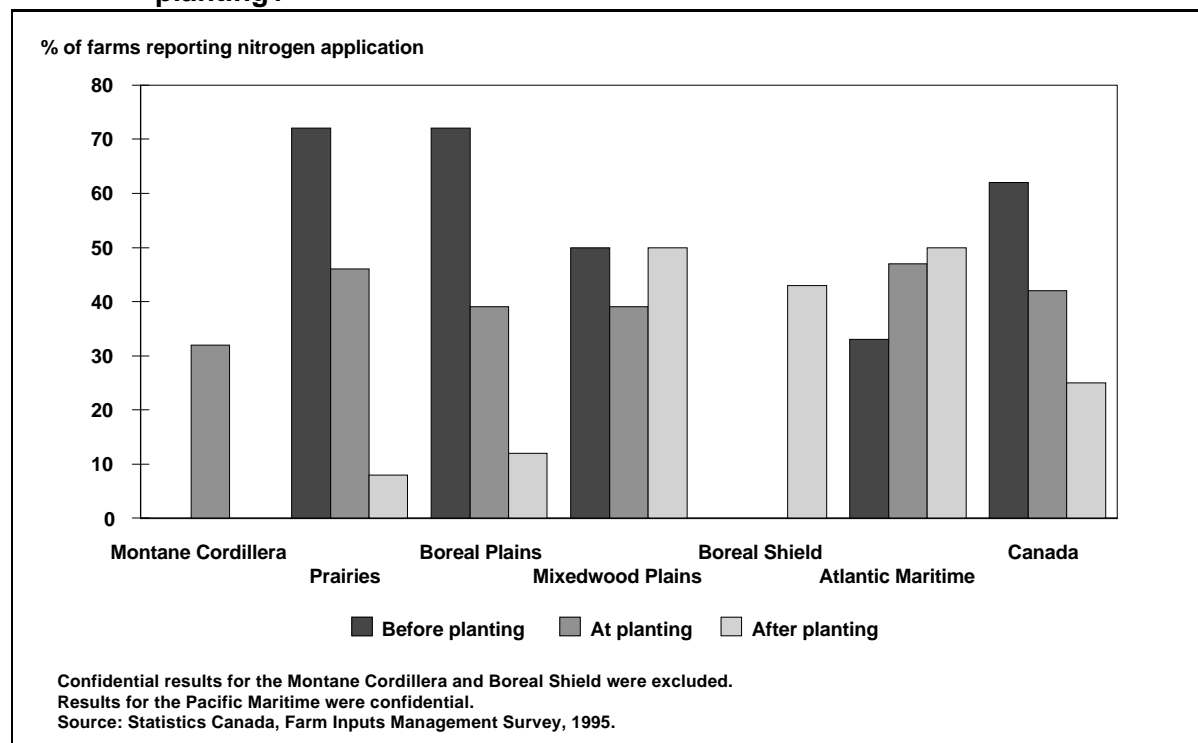
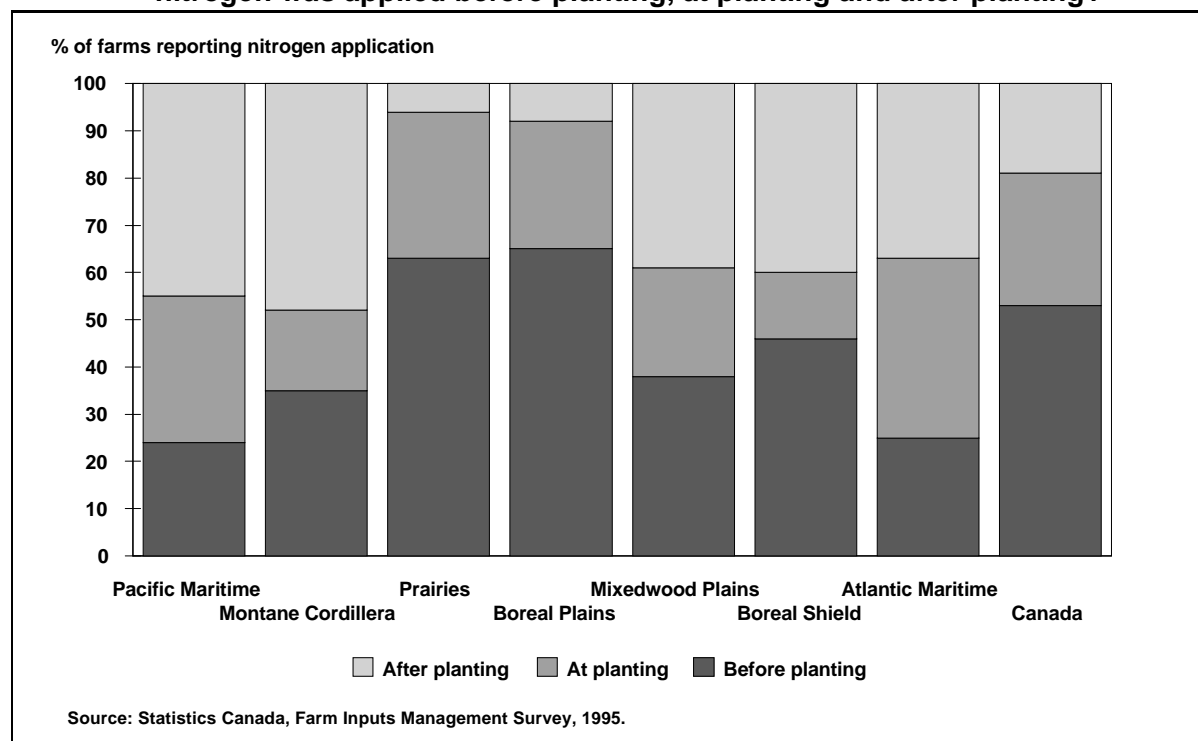


Figure 30: Of the total amount of nitrogen applied in 1995, what percentage of total nitrogen was applied before planting, at planting and after planting?



Legume Ploughdown

Figure 31 illustrates the proportion of farms reporting nitrogen application that reported they grew legumes for ploughdown in 1995. Of farms that applied commercial nitrogen to their crops, 15% (14,580 farms) grew legumes solely for ploughdown. The highest proportion of farms was in the Mixedwood Plains at 29% while the Prairies reported the lowest proportion of farms reporting at 5%.

Figure 31: Are legumes grown on this farm solely for ploughdown?

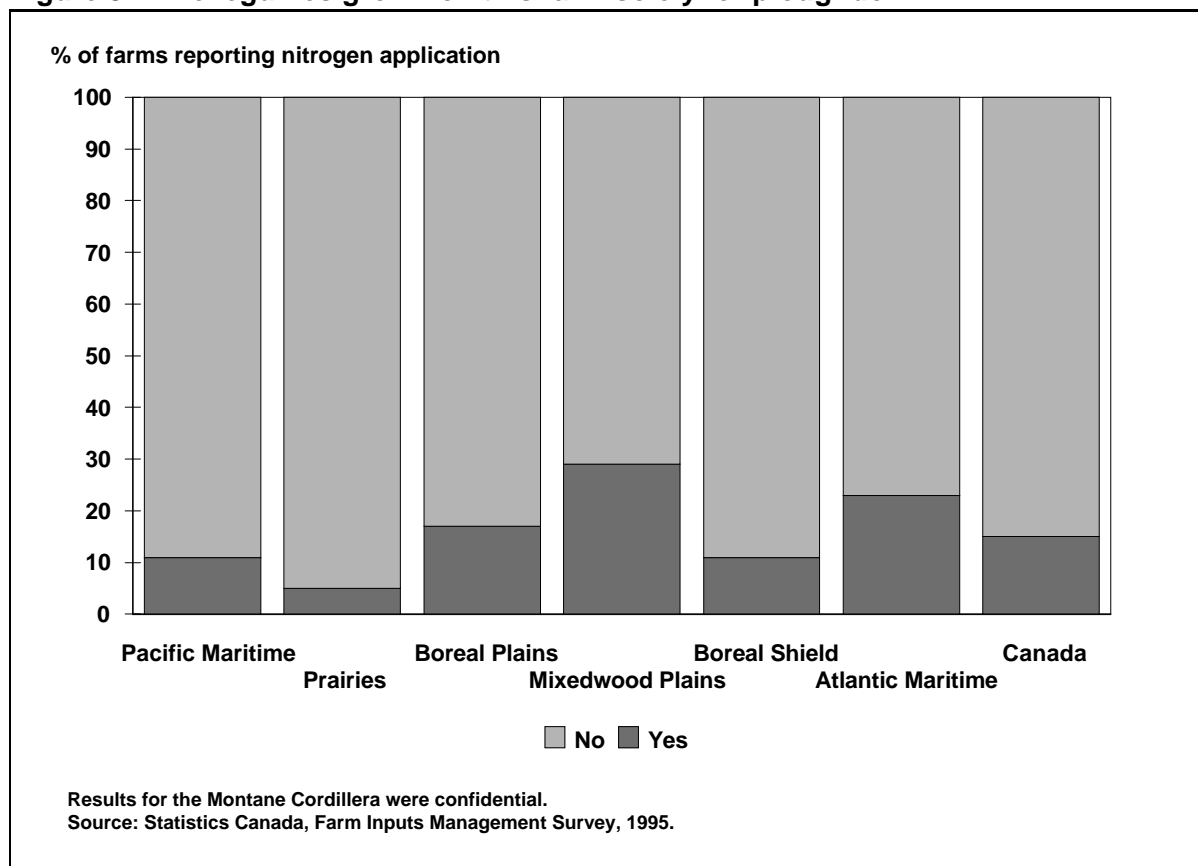
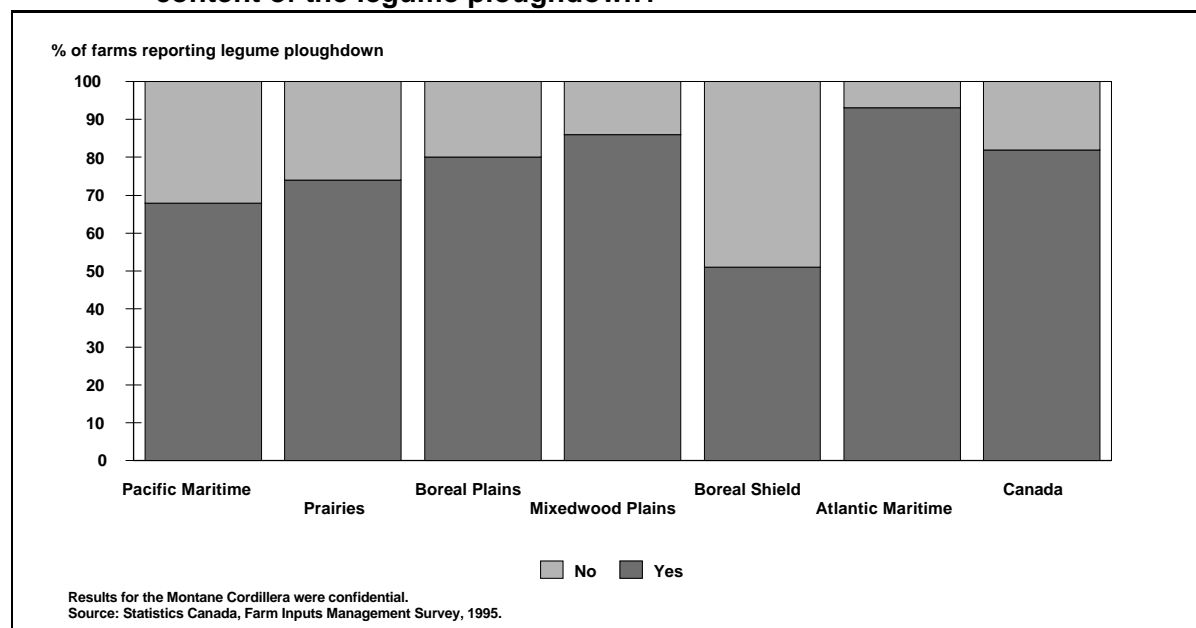


Figure 32 on page 36 shows the proportion of farms that reduced the amount of commercial nitrogen to offset the nutrient content of the legume ploughdown by ecozone. Of Canadian farms reporting that they used legume crops solely for ploughdown in 1995, approximately 82% (12,010 farms) reduced the amount of commercial nitrogen to offset the nutrient content of the legume ploughdown. The highest proportions of farms reporting reductions in the amount of commercial nitrogen due to legume ploughdown were in the Atlantic Maritime at 93%, followed by the Mixedwood Plains at 86%.

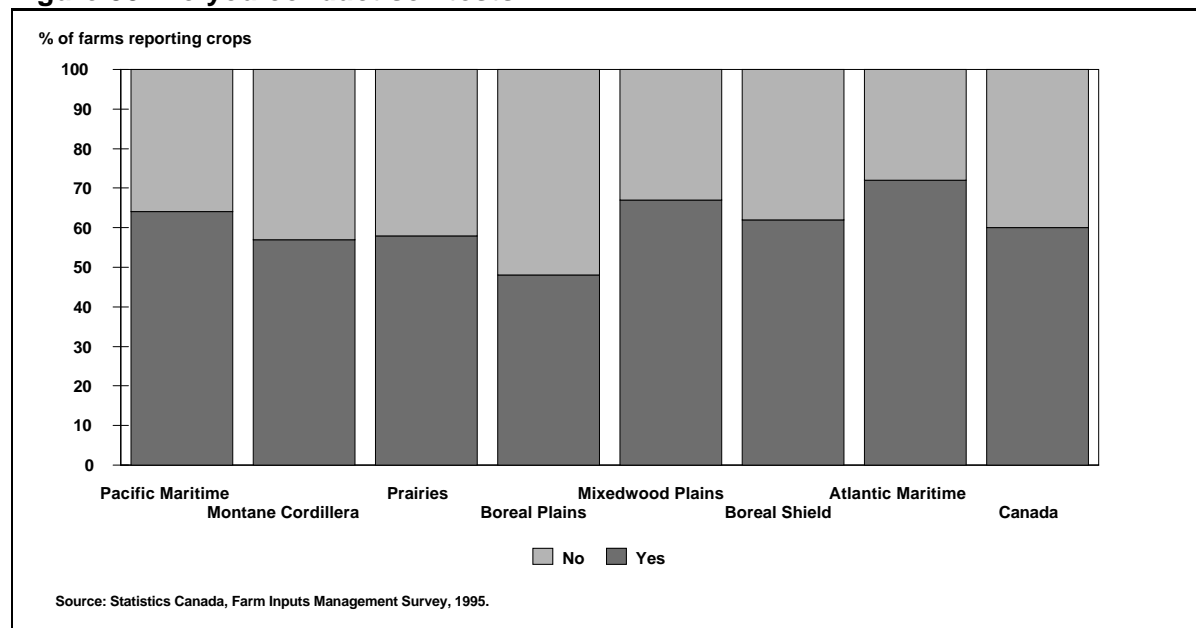
Figure 32: Do you reduce the amount of commercial nitrogen to offset the nutrient content of the legume ploughdown?



Soil Testing

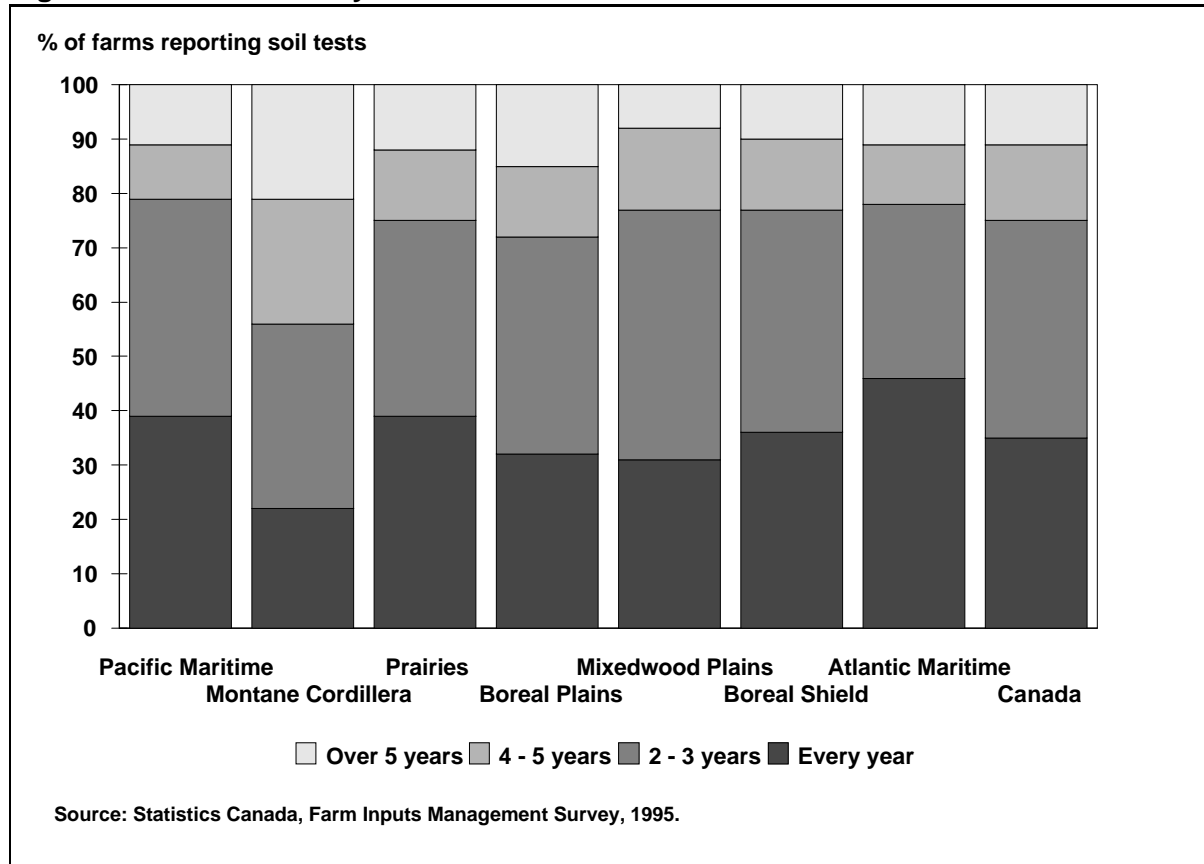
Figure 33 illustrates the proportion of farms reporting that they conducted soil tests, broken down by ecozone. Of farms surveyed, 60% (124,050 farms) reported that they conducted soil tests. The highest proportion of farms using soil tests was in the Atlantic Maritime at 72%, followed by the Mixedwood Plains at 67%. The Boreal Plains reported the lowest proportion at 48%.

Figure 33: Do you conduct soil tests?



Of farms surveyed that conducted soil tests, approximately 35% of farms soil tested every year, 40% every two to three years, 14% every four to five years and 11% once every five years or longer. Figure 34 shows how often producers do soil tests by ecozone. A farmer was considered to have conducted soil tests if soil testing had been done on any of the farm's crop land. The farmer did not need to have every field tested. The highest proportions of farms reporting that they soil tested every year were in the Atlantic Maritime at 46% and the Prairies and the Pacific Maritime at 39% each. The Montane Cordillera reported the lowest proportion using soil tests every year at 22% and the highest proportion doing soil tests only every 6 or more years at 21%.

Figure 34: How often do you soil test?



Section 4: Pesticide Management

The following section presents the results of FIMS for pesticide management on an ecozone basis. The first few questions display the background information on the level of pesticide use and the methods used to determine when to apply pesticides. The second set of questions relates to sprayer calibration. The final question examines alternative pest control methods other than commercial pesticides.

Pesticide Application

Of farms reporting that they grew crops in 1995, including hay and forages, approximately 67% (138,535 farms) applied herbicides to their crops. Figure 35 illustrates the breakdown of respondents at the ecozone level. Consistent with the large number of dryland grain farms, farmers in the Prairies ecozone reported the highest proportion of farms that applied herbicides at 83%.

Figure 35: In 1995, were herbicides applied to the crops?

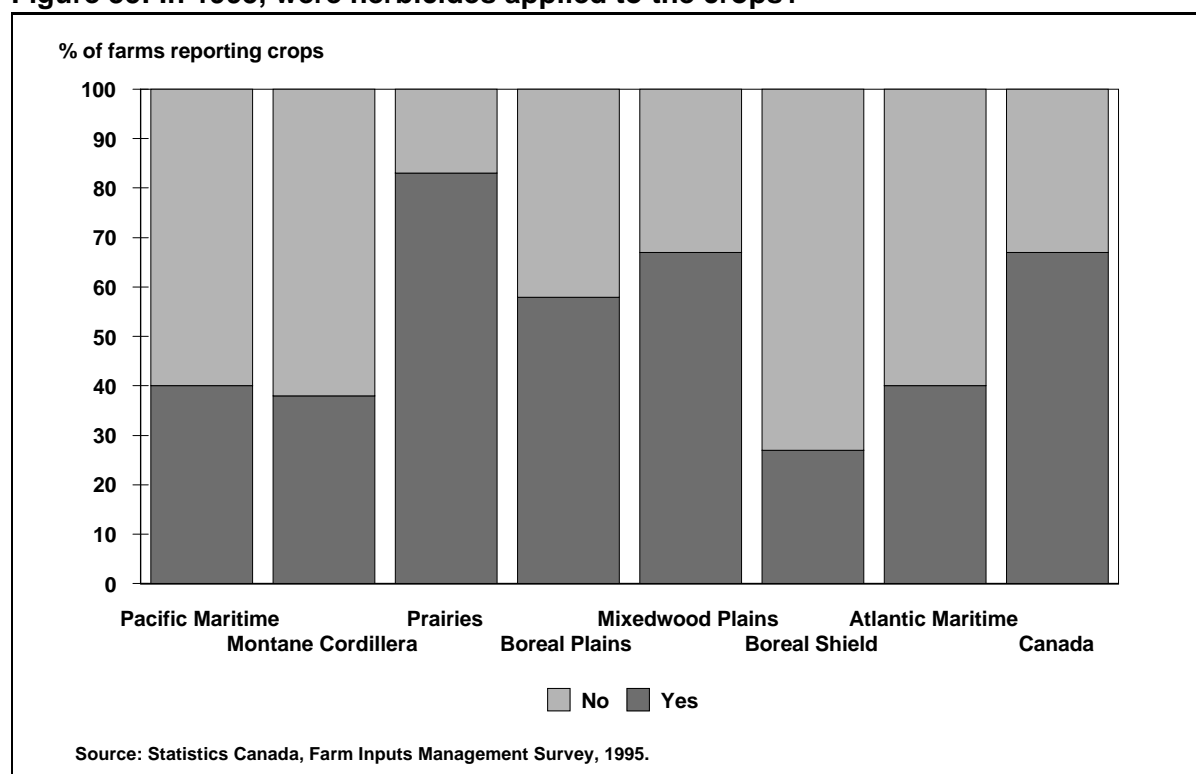
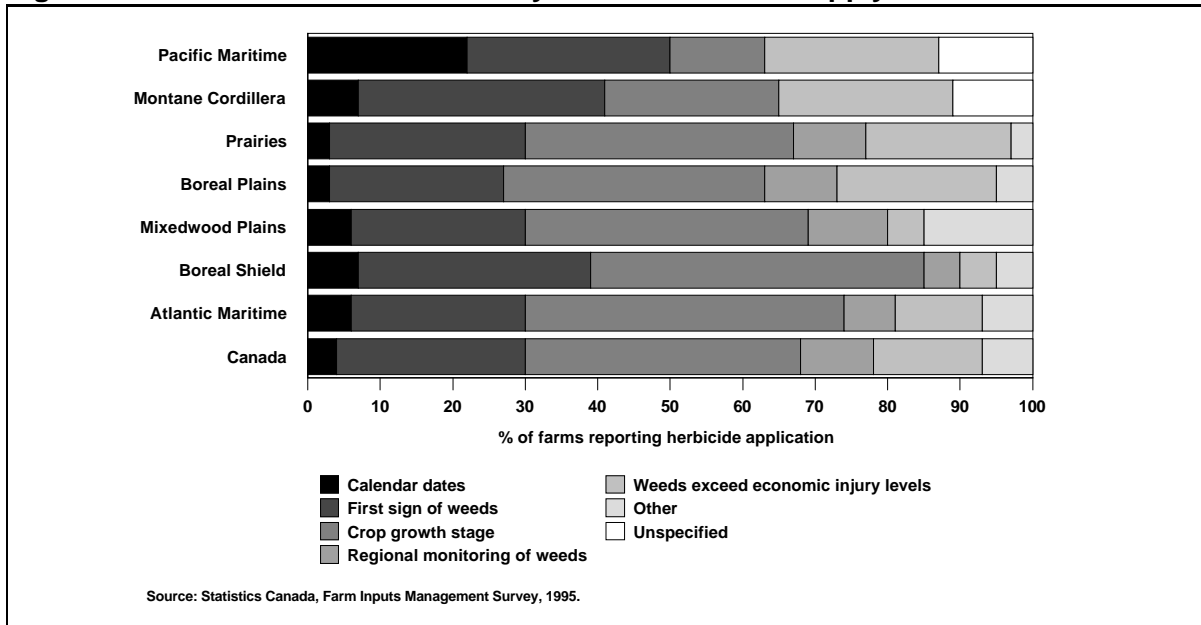


Figure 36 shows the various methods used by farmers who reported using herbicides to determine when to apply herbicides to crops. From an environmental sustainability perspective, waiting until the economic threshold injury level is exceeded is the best management practice. The economic injury level is the point at which losses from crop damage become great enough to justify herbicide expenditures. The crop growth stage was

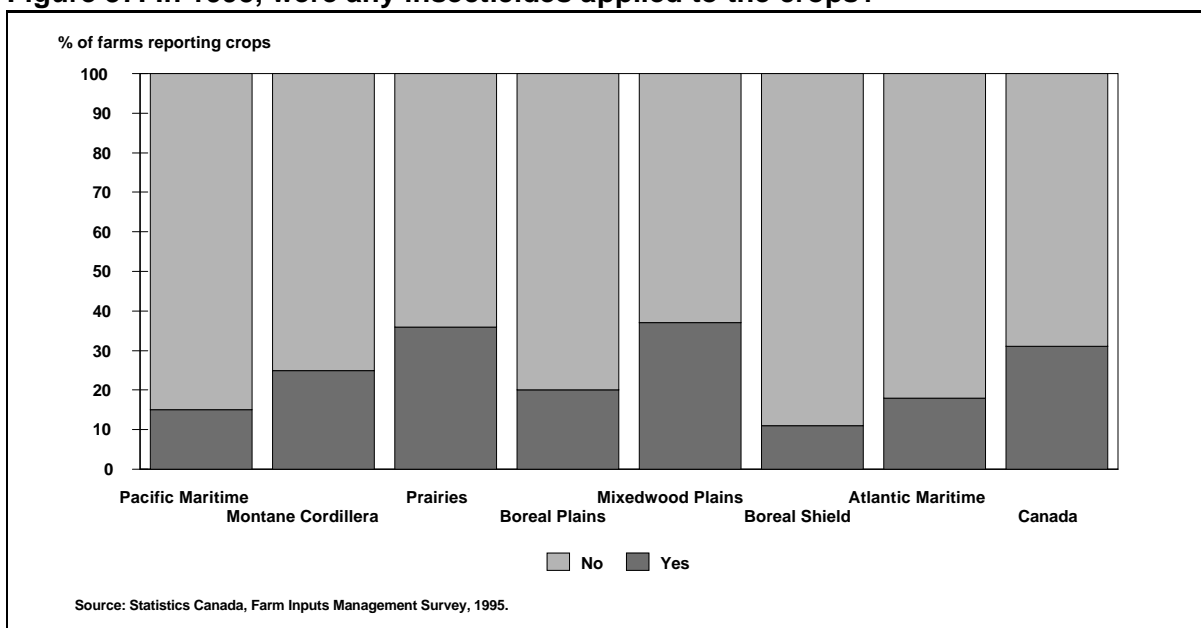
reported as the most popular method to determine when to apply herbicides in all ecozones except the Pacific Maritime and Montane Cordillera. Here, the first sign of weeds was used most often to determine when herbicides should be applied.

Figure 36: Which best describes how you decide when to apply herbicides?



Of farms reporting that they grew crops in 1995, approximately 31% (62,270 farms) reported that they applied insecticides to crops. Figure 37 illustrates the breakdown of respondents at the ecozone level. Farms in the Prairies and the Mixedwood Plains reported the highest proportions of farms that applied insecticides at 36% and 37%, respectively.

Figure 37: In 1995, were any insecticides applied to the crops?



Of farms reporting that they grew crops in 1995, approximately 19% (39,520 farms) reported that they applied fungicides to crops. Figure 38 illustrates the results at the ecozone level. Farms in the Mixedwood Plains, the Prairies and the Montane Cordillera reported the highest proportions of farms that applied fungicides at 24%, 20% and 20%, respectively.

Figure 38: In 1995, were any fungicides applied to the crops?

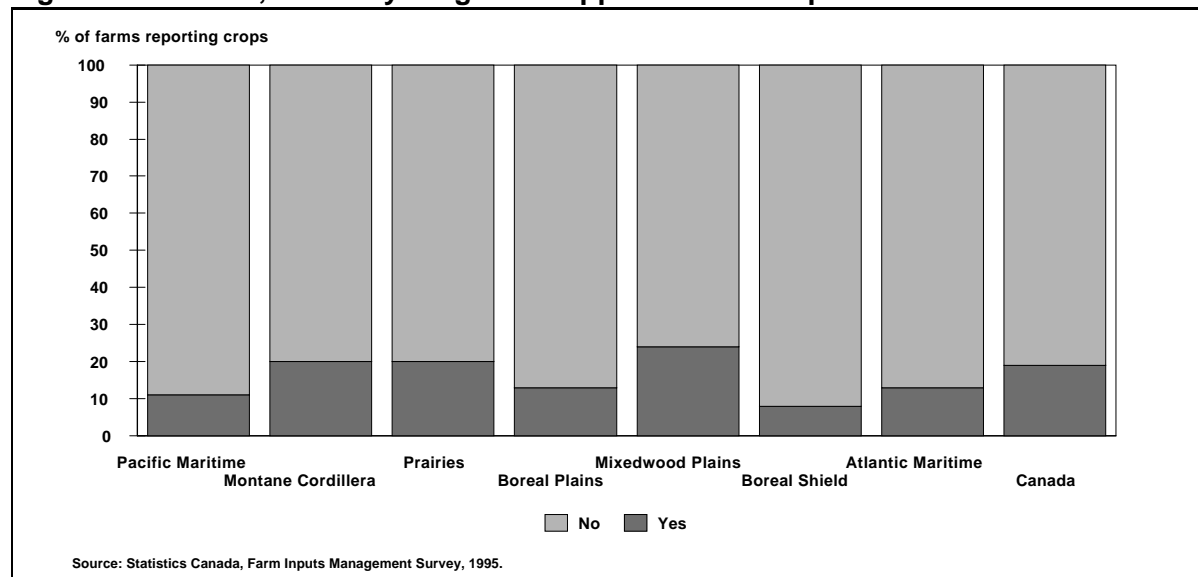
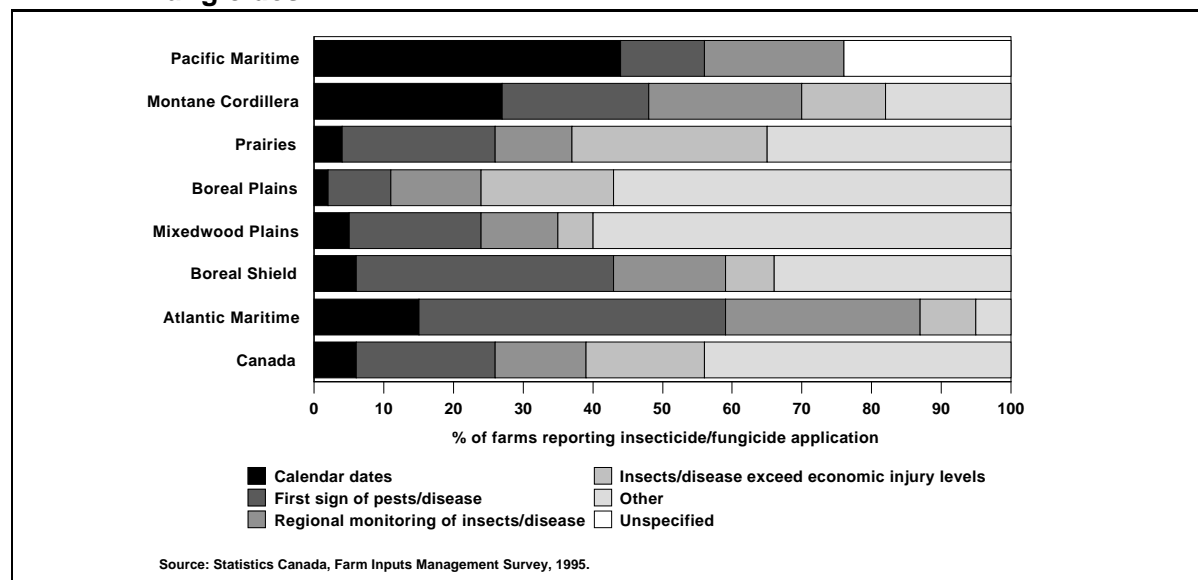


Figure 39 shows the various methods used to decide when to apply insecticides and fungicides for farms that reported using insecticides and fungicides in 1995. Farms in the Pacific Maritime and the Montane Cordillera ecozones listed calendar dates as the most common method of deciding when to apply insecticides and fungicides. Farms from the Boreal Shield and Atlantic Maritime listed first sign of pests as the most common method for deciding when to apply these types of pesticides.

Figure 39: Which best describes how you decide when to apply insecticides/ fungicides?



Sprayer Calibration

Approximately 76% of farms that reported applying pesticides to crops in 1995 operated their own sprayer. At 110,875 farms, this was almost half of the farms represented by the survey. Figure 40 illustrates the breakdown of respondents at the ecozone level.

Figure 40: Do you operate your own sprayer?

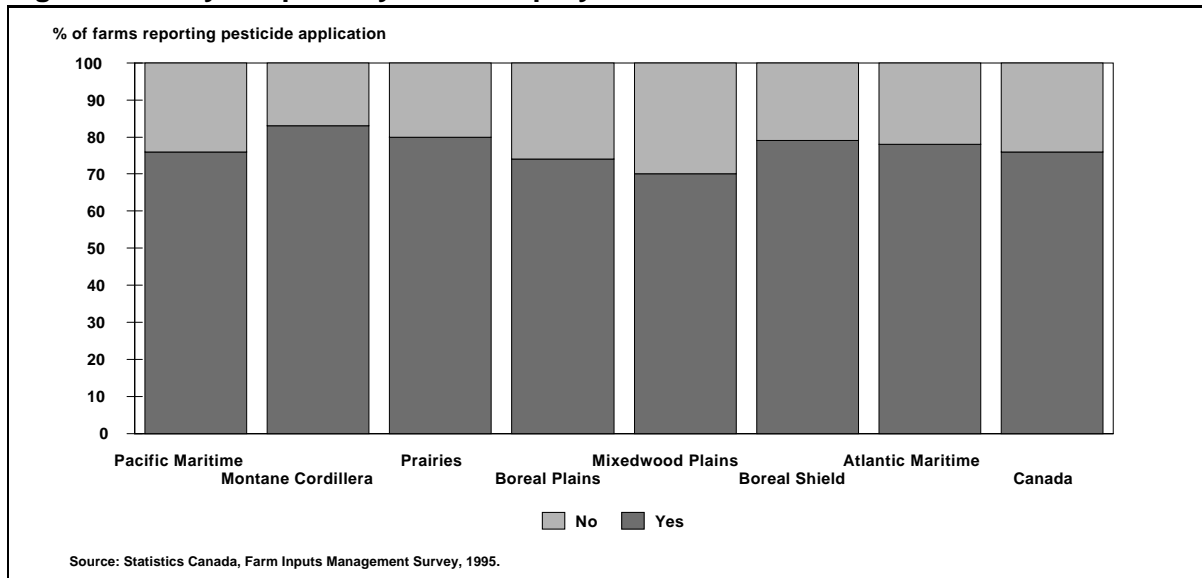
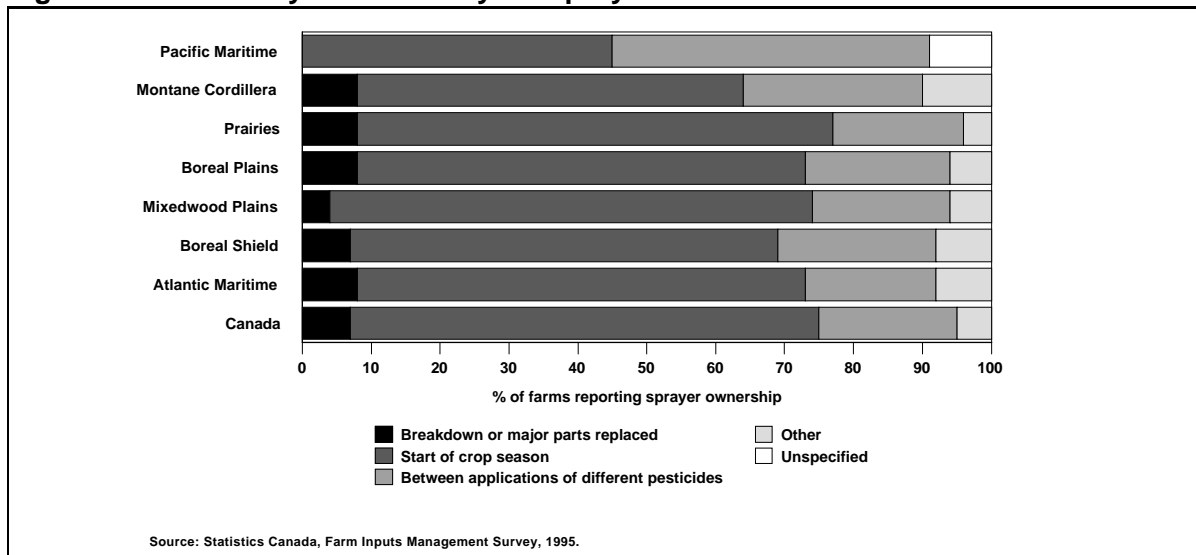


Figure 41 provides the breakdown by ecozone of when the sprayer was calibrated on farms that did their own spraying. Across Canada, 75,515 farms, approximately 68%, calibrated their sprayer only at the start of the crop season. This was reported as the most common practice in all ecozones with the exception of the Pacific Maritime. Here, both the start of the crop season and between applications of different pesticides were reported as being equally important. The best management practice is to calibrate the sprayer between applications of different pesticides.

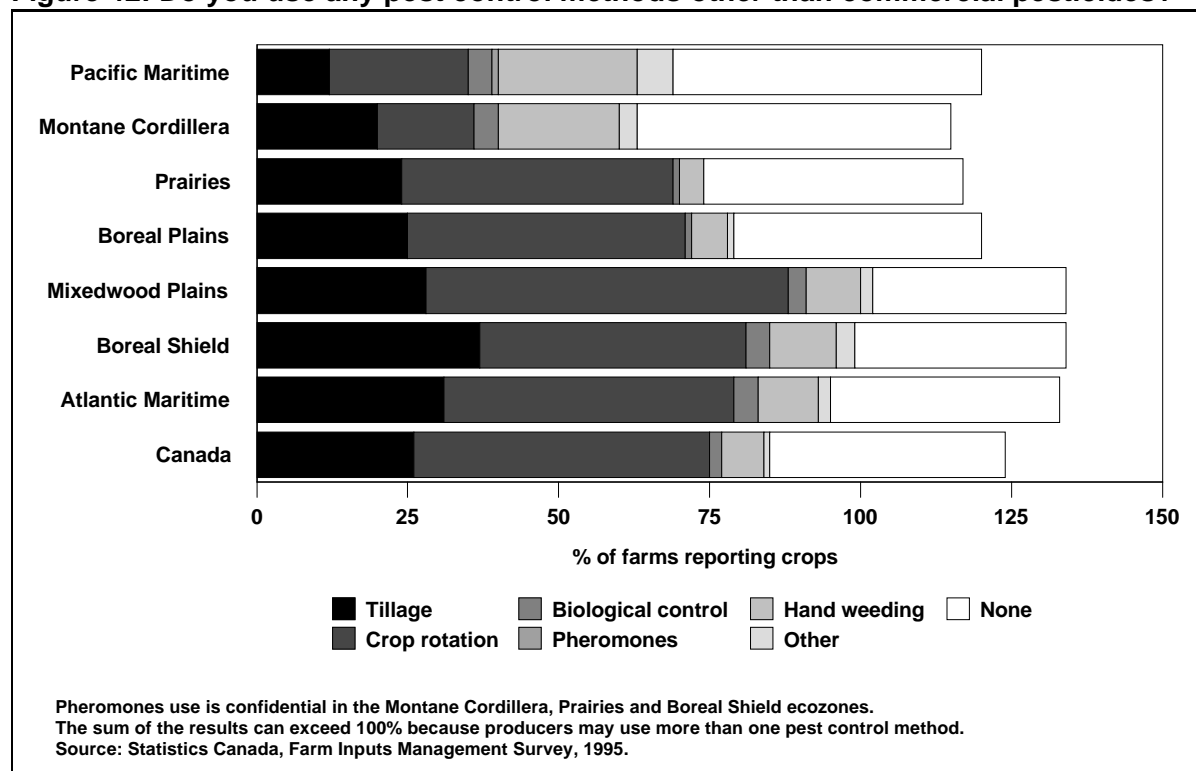
Figure 41: When do you calibrate your sprayer?



Other Pest Control Methods

A number of nonchemical pest control methods have been used as an alternative to pesticides. Of Canadian farms that indicated growing crops in 1995, approximately 49% listed crop rotations as an alternative method to control pests, 26% listed tillage, 7% listed hand weeding, 2% listed biological control and 1% listed other methods. A further 39% listed no nonchemical pest control practices. Figure 42 provides the breakdown by ecozone of the pest control methods other than commercial pesticides.

Figure 42: Do you use any pest control methods other than commercial pesticides?



Conclusion

The objective of the 1995 Farm Inputs Management Survey was to provide information on farm input management practices. The results presented here yield insight into the environmentally-related input practices used by farmers in each ecozone. FIMS information can be combined with environmental data from other sources, such as the Census of Agriculture or from a geographic information system, to create a more complete picture of inputs management in an agri-environmental context. Additional analysis and interpretation of selected key FIMS variables will be reported in a comprehensive report on agri-environmental indicators by Agriculture and Agri-Food Canada in the coming year.

This report provides examples of the types of information that are available from the survey. However, not all of the various interests of environmental researchers can be addressed in a single document such as this because of the very specific data needs of many research efforts. The information available from FIMS can be tailored in any number of ways to address specific input management issues of environmental concern. Even though this report presents the result of the 1995 FIMS in some detail, further special tabulation can be prepared by contacting Statistics Canada.

As this report shows, FIMS has made a valuable contribution to an analysis of the current state of farm input management practices by providing previously unavailable data. However, there are still a number of limitations with a single survey. The numbers by themselves do not provide a full description of the environmental issues, only a snapshot of the current situation. Follow-up work is required to determine if current practices are beneficial, neutral or harmful to the environment. FIMS provides only a baseline and provides little indication about improvements or deterioration in input management practices over time. A second survey would be required to provide an assessment of changes in adoption of particular management practices.

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Appendix A: Description of the Agri-Environmental Indicators (AEI)

Farm Resource Management: Tracks uptake by farmers of environmentally-sustainable management practices by measuring soil residue cover and management of agricultural land, fertilizers, pesticides and manure.

Soil Degradation Risk: Measures progress in reducing the vulnerability of agricultural soils to degradation processes and identifies soils remaining at high risk from erosion, salinization or loss of organic matter.

Water Contamination Risk: Assesses progress in reducing the risk of water contamination from pesticides and nutrients used in agriculture and identifies areas of risk of contamination.

Agroecosystem Greenhouse Gas Balance: Estimates trends in the net balance between accumulation and release of the three major greenhouse gases emitted by agriculture: carbon dioxide, nitrous oxide and methane.

Agroecosystem Biodiversity Change: Monitors biodiversity in agricultural ecosystems by measuring changes in habitat availability, and species diversity and abundance.

Input Use Efficiency: Tracks the amounts of environmentally-sensitive inputs required to produce agricultural products by measuring the efficiency of fertilizers, pesticides, energy and irrigation water being used by farmers.

Refer to the following publications for additional information:

- Agriculture and Agri-Food Canada, *Developing Environmental Indicators for Agriculture*, Report No. 1, June 1993.
- Agriculture and Agri-Food Canada, *Role and Nature of Environmental Indicators in Canadian Agricultural Policy Development*, Paper presented to the Symposium of the Resource Policy Consortium on Environmental Indicators, June 1995.

These publications form part of an extensive list of Agriculture and Agri-Food Canada publications that are available on the Agri-Environmental Indicators Project.

Appendix B: Statistical details of the 1995 Farm Inputs Management Survey (FIMS)

The 1995 Farm Inputs Management Survey is an initiative by Agriculture and Agri-Food Canada and Statistics Canada to address a data gap at the national level regarding the management of three farm inputs: manure, commercial fertilizers and commercial pesticides. The data that were collected on the adoption and use of selected management practices by Canadian farmers will contribute to the Agri-Environmental Indicator Project being undertaken by Agriculture and Agri-Food Canada. This project supports the larger policy goal of integrating environmental considerations into decision-making processes at all levels of the agri-food sector. A core set of regionally-sensitive national indicators is being developed that builds on and enhances the information base currently available on environmental conditions and trends related to primary agriculture in Canada. The results of the Farm Inputs Management Survey make a significant contribution to this goal.

The Farm Inputs Management Survey also complements the questions on land management practices that were added to the Census of Agriculture for the first time in 1991. The questions track on-farm adoption rates of land management practices for tillage, erosion and weed control, as well as the use of conservation structures such as windbreaks and grassed waterways. Building on the baseline created in 1991, a new question dealing with manure application methods has been added to the 1996 Census of Agriculture. Although coverage was not as comprehensive as the census, the Farm Inputs Management Survey provides data on the adoption and use of a further set of farm inputs management practices for the same reference year.

The following section contains excerpts from the Statistics Canada publication, *Farm Inputs Management Survey, 1995*.

Collection

The survey was conducted from December 6 - 20, 1995. With harvest completed, this time was less hectic for producers than other times of the year, and still soon enough after the crop season that facts about various practices used during the season could still be remembered. As a result, the response rate was high because most farm operators were available to conduct the interview. Other benefits included comparability with the results of the 1996 Census of Agriculture, which has the same reference period.

The survey was conducted using the computer assisted telephone interview (CATI) approach.

Target Population: The target population of the Farm Inputs Management Survey consisted of all farms in Canada (excluding the Yukon and Northwest Territories) that were in operation at the time of the survey. A list of farms taken from the 1991 Census of Agriculture was used to determine which farms would be included in the sample frame. Because of certain constraints on data collection, some farms were excluded from the population: farms whose sales of agricultural products were less than \$2,000, farms located on Indian reserves, institutional farms, community pastures, and multi-holding companies.

Stratification: The list of farms was stratified by ecozone (only those with farms in 1991), province and farm type. Each ecozone is an approximate grouping of census enumeration areas sharing common ecological and environmental characteristics. Canada is composed of fifteen different ecozones, seven of which have a significant number of farms. These ecozones were stratified by province and farm type. Each farm type is a grouping of farms which receive most of their agricultural sales from a given commodity (e.g., beef farms). Since the number of farms in each grouping is different in each province, the set of farm types varies from province to province.

Sample Allocation: The total sample size was set at 6,000 farms. Allocation proportional to population size was used, with a minimum sample size of 58 farms per stratum. This threshold was designed to ensure representation of farms with unusual characteristics within each stratum. An unusual characteristic is a feature found in at most 5% of a stratum's population.

Tables B.1 and B.2 show the population and sample size for each province and ecozone with farms.

Table B.1: Population and sample size by province

Province	Number of Farms in the Population	Number of Farms in the Sample
Newfoundland	504	116
Prince Edward Island	2,115	174
Nova Scotia	3,310	174
New Brunswick	2,680	174
Quebec	34,671	781
Ontario	61,021	1,211
Manitoba	22,636	634
Saskatchewan	56,031	1,146
Alberta	52,286	1,067
British Columbia	14,933	523
Canada	250,187	6,000

Table B.2: Population and sample size for ecozones with farms

Ecozone	Number of Farms in the Population	Number of Farms in the Sample
Pacific Maritime	6,510	174
Montane Cordillera	7,390	233
Prairies	92,055	1,817
Boreal Plains	39,333	1,030
Mixedwood Plains	75,704	1,481
Boreal Shield	10,937	489
Atlantic Maritime	18,258	776
Canada	250,187	6,000

Table B.3 shows the number of farms in the population by ecozone and by province.

Table B.3: Population by ecozone and province

Province	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	Total
	Number of Farms in the Population							
Newfoundland	0	0	0	0	0	504	0	504
Prince Edward Island	0	0	0	0	0	0	2,115	2,115
Nova Scotia	0	0	0	0	0	0	3,310	3,310
New Brunswick	0	0	0	0	0	0	2,680	2,680
Quebec	0	0	0	0	18,744	5,774	10,153	34,671
Ontario	0	0	0	0	56,960	4,061	0	61,021
Manitoba	0	0	16,343	5,695	0	598	0	22,636
Saskatchewan	0	0	44,996	11,035	0	0	0	56,031
Alberta	0	268	30,716	21,302	0	0	0	52,286
British Columbia	6,510	7,122	0	1,301	0	0	0	14,933
Canada	6,510	7,390	92,055	39,333	75,704	10,937	18,258	250,187

Table B.4 shows the number of farms in the sample by ecozone and province.

Table B.4: Sample size by ecozone and province

Province	Pacific Maritime	Montane Cordillera	Prairies	Boreal Plains	Mixedwood Plains	Boreal Shield	Atlantic Maritime	Total
	Number of Farms in the Sample							
Newfoundland	0	0	0	0	0	116	0	116
Prince Edward Island	0	0	0	0	0	0	174	174
Nova Scotia	0	0	0	0	0	0	174	174
New Brunswick	0	0	0	0	0	0	174	174
Quebec	0	0	0	0	386	141	254	781
Ontario	0	0	0	0	1,095	116	0	1,211
Manitoba	0	0	344	174	0	116	0	634
Saskatchewan	0	0	882	264	0	0	0	1,146
Alberta	0	58	591	418	0	0	0	1,067
British Columbia	174	175	0	174	0	0	0	523
Canada	174	233	1,817	1,030	1,481	489	776	6,000

The response rate was 93.1%. Response rate refers to the number of survey contacts who were still operating a farm at the time of the survey.

Estimation

After processing for partial non-response, the data were used to produce estimates.

Calculation of Sampling Weights: The sampling weights were derived by taking the ratio of the number of farms in the population to the observed sample size in each stratum. Farms that supplied no valid data, could not be contacted or refused to participate were excluded from the calculation of observed sample sizes, thereby increasing the sampling weights of the other farms selected.

Calculation of Estimates: The ratio method was used to estimate the farm inputs management variables. In each ratio the numerator was an estimate of the number of farms with a particular characteristic in a particular domain (ecozone, farms storing manure, and so on), and the denominator was an estimate of the total number of farms in this domain. The method of using estimates in the numerator and the denominator is known as simple expansion estimation. The estimates are based on the sampling weights described above.

Data Confidentiality

All tabulated data are subject to restrictions prior to release. A number of computerized checks are performed on all data cells to prevent publication or disclosure of any information concerning any particular farm operation.

For each of the tabulations produced, the estimated number of farms is rounded to the base “5” and the estimates of the other variables within the table are adjusted by a variable factor. Should the degree of detail required to answer user requests create confidentiality concerns, the affected data or the entire table will be automatically suppressed by the data system. In this way, confidentiality of the data is preserved without jeopardizing the quality of the estimates.

Data Reliability

The statistics contained in this publication are estimates derived from a sample survey of agricultural operators and, as such, are subject to sampling and non-sampling errors. The quality of the estimates thus depends on the combined effect of these types of errors.

Sampling Errors: These errors occur because observations are made only on a sample and not on the entire population. The sampling error depends on such factors as the size of the sample, the variability of the characteristic of interest in the population, the sampling design, and the method of estimation. For example, for a given sample size, the sampling error will depend on the stratification procedure employed, allocation of the sample, choice of the sampling units and method of selection.

In sample surveys, since inference is made about the entire population covered by the survey on the basis of data obtained from only part of the population, the results are likely to be somewhat different than if a complete census was taken under the same general survey conditions. The most important feature of probability is that the sampling error can be measured from the sample itself.

Non-Sampling Errors: Non-sampling errors can occur whether an estimate is based on a sample or on a complete census of the population. These errors may be introduced at various stages of the survey (such as frame definition, collection, capture, non-response, editing, weighting, tabulation, etc.) and include the response errors introduced inadvertently by the farm operators. All efforts are taken to minimize non-sampling errors through extensive edits and data analysis. However, some limitations have been identified. For example, respondents may have been hesitant to answer sensitive questions, and there may have been a bias towards providing the “environmentally correct” answer. While some of these non-sampling errors may be minimized by making changes to the questionnaire, they will never be totally eliminated.

Notes to Data Users

Because some farms were excluded from the population, the total number of farms indicated by the survey results underestimates the total number of actual farm operations in Canada. Refer to “Target Population” on page B-2 for discussion of the exclusions.

The estimates are slightly altered by the confidentiality method used. Each estimated number of farms is randomly rounded and then the estimates of the other variables are adjusted by a variable factor.

For further information regarding the Farm Inputs Management Survey, refer to:

- Statistics Canada, *Farm Inputs Management Survey, 1995* (Catalogue No. 21F0009XPE).

Appendix C: Description of the Ecozones of Canada with Significant Agricultural Activity

This appendix provides a brief description of the seven ecozones of Canada that contain significant levels of agricultural activity. The descriptions were gleaned from the publication *A National Ecological Framework for Canada (Ecological Stratification Working Group, 1995)*. The ecozones are described in approximately a west to east order. Refer to Figure 1, “Terrestrial ecozones of Canada” on page 5 of the *Introduction* for a map indicating the boundaries of the ecozones of Canada.

Pacific Maritime

The western most agricultural ecozone, the Pacific Maritime, runs in a narrow band along the Pacific coast mainland and includes British Columbia’s numerous offshore islands. The ecozone is characterized by coastal plains backed by mountainous regions. The ecozone has Canada’s warmest and wettest climate, consisting of mild, humid conditions at lower elevations along the coasts and cool, very humid conditions at higher elevations in the mountains. Having a maritime climate, temperatures are moderated by the Pacific Ocean. Variations in climatic conditions are due to changes in elevation. The coastal plains are covered by ancient and old growth temperate coniferous forests which extend into the mountain regions. Alpine conditions are found in the mountains, which are cut by fjords and glacial valleys. Forestry is the most important economic activity that is carried out in the ecozone. Fishing and tourism are also important. Agricultural activities take place on the highly productive soils of the Fraser Valley and southeastern Vancouver Island. The majority of the 6,500 farming operations are found in these regions. Both regions also contain the dense urban population base.

Montane Cordillera

Mountains and interior plains dominate the topography of the Montane Cordillera ecozone, which includes most of southern interior British Columbia and the southwestern corner of Alberta. The ecozone is considered to be Canada’s most diverse and includes alpine tundra, dense coniferous forests, dry grasslands and deep lakes. Climatic conditions range from arid and mild in the southern valleys to humid and cold in the mountains. Rain shadows and wet belts result because of the rugged mountainous terrain. Large interior plains are found in the northern part of the ecozone while the southern part contains mountain valleys. Forestry is an important economic activity, particularly in the northern interior. Mining, oil and gas and tourism are other important economic activities. Farms and rangelands are found mainly in the southern valleys. Crops and hay are grown where irrigation is available. Important orchard and vineyard areas are also found in the southern valleys. There are about 7,400 farms in this ecozone.

Prairies

The Prairies ecozone, covering southern Alberta, Saskatchewan and Manitoba, is an extension of the grasslands of the North American Great Plains. The topography is relatively flat, with large open grasslands and few forests. The area is very conducive to modern mechanized agriculture and has seen the greatest influence of human activity of any ecozone. The Prairies ecozone has a continental climate with short, hot summers and long, cold winters. The ecozone receives low levels of precipitation and is semiarid in places. While strong winds contribute to high evaporation, high natural soil fertility and good moisture holding capacity contribute to a highly productive agriculture. The wetlands are important habitats for half of North America's waterfowl. Agriculture is the dominant economic activity in the ecozone and there are approximately 92,100 farms in operation. The Prairies ecozone contains more than 60% of Canada's cropland and 80% of the rangeland and pasture. Mining and oil and gas are also important economic activities.

Boreal Plains

The Boreal Plains ecozone, which forms a band immediately north of the Prairies ecozone, extends from the Peace River region of northeastern British Columbia to the southeastern corner of Manitoba. The ecozone's continental climate consists of cold winters and warm summers. The ecozone is covered by coniferous forests in the north, with an increasing proportion of deciduous trees moving toward the south. Topographically, the ecozone is a gently rolling plain. Agriculture occurs predominantly in the southern part of the ecozone, though farms are also found in the Peace River region. An important agricultural region, there are more than 39,300 farms in the ecozone. Forestry, particularly pulp and paper, mining, oil and gas and tourism are also important.

Mixedwood Plains

The Mixedwood Plains ecozone consists of the St. Lawrence River valley of Quebec and Ontario and the inter-Great Lakes region of southern Ontario. The ecozone is the most populated in Canada and the most intensely developed. Approximately half of the population of Canada lives in the ecozone. The climate consists of warm summers and cool winters. Once heavily forested, the Mixedwood Plains ecozone contains the greatest variety of tree species in Canada, though only about 10% of the forests, mostly a mixture of coniferous and deciduous trees, remains. Though relatively small in land area, the ecozone is very important agriculturally. The fertile soils, warm growing season, abundant rainfall and gentle topography of rolling hills and level plains result in a very productive and varied agriculture. The ecozone contains the most productive soils in Canada. Dairy, beef, poultry and eggs, and grains and oilseeds are important agricultural commodities. Orchards, fruit and vegetable production and vineyards can also be found throughout the ecozone. There are approximately 75,700 farm operations in the Mixedwood Plains.

Boreal Shield

In terms of land area, the Boreal Shield ecozone, which extends from northern Saskatchewan through Newfoundland, is the largest ecozone in Canada. Largely wilderness, the Boreal Shield is a mix of forests, wetlands, granite outcroppings and rolling uplands. The topography features land forms left behind by retreating glaciers. The continental climate results in long, cold winters and short, warm summers. Maritime conditions along the Great Lakes and the Atlantic Ocean moderate winter and summer temperatures. About 80% of the ecozone is covered by forests. Conifers are found throughout the ecozone, though deciduous trees increasingly appear toward the south. Urban centres have developed around the ecozone's resource bases. Agriculture is limited to a few areas of fertile soil and suitable microclimate. Given the limited available cropland, beef cattle farming predominates. Dairy production, though, is also important. There are only about 10,900 farms in this vast ecozone.

Atlantic Maritime

The Atlantic Maritime ecozone encompasses all of the provinces of Prince Edward Island, Nova Scotia and New Brunswick and the southeastern part of Quebec. The ecozone has a cool, moist maritime climate and temperatures are moderated by the Atlantic Ocean. Though mixed coniferous and deciduous forests covered the ecozone, little old growth forest remains. The ecozone consists of two predominant geographic features. The Appalachian Upland in the interior is made up of granite and other hard, crystalline rocks, while the Northumberland Coastal Plain contains more fertile soils and most of the agricultural activity. Population centres are also found largely along the coast. Forestry and mining, as well as agriculture, are important economic activities. Historically, the fisheries have also been important. Approximately 18,250 farms are located in the Atlantic Maritime ecozone. Over one-third of the farms in the ecozone are dairy producers, an activity consistent with limited acreages of good quality farm land. Beef, poultry and eggs and fruits and vegetables are also important agricultural products.