RURAL ECONOMY

PROJECT REPORT

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SOIL EROSION IMPLICATIONS OF SELECTED AGRICULTURAL PROGRAMS

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Project Report 90-09

with

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PREFACE

The tasks involved in this study have included understanding and describing programs, and designing and using evaluative approaches. These have required a variety of skills, with input from and consultation with numerous individuals both within and beyond the study team.

Among members of the study team, Harvey Clark undertook many of the tasks concerning obtaining and reporting questionnaire results. He also gathered information regarding all programs, and performed a range of research and writing functions. J.H. Copeland was the link to successful operation of long-period simulations with the EPIC model, and ensured that the computing needs of the study were met. P. Barlott prepared first drafts describing the farm fuel rebate program and the farm tax assessment program.

Among the major authors, J.A. Robertson contributed a knowledge of soil fertility issues raised by the study. M.S. Anderson was primarily responsible for sections dealing with Canada-Alberta crop insurance, Special Canadian Grains program, drought assistance, Crown lands dispositions, and water management programs. In addition, he contributed to all sections of the report (including in particular the method for analyzing farmers' perceptions of the degree of soil loss by program). M.L. Lerohl, the principal author, was responsible for several chapters of the report, and for the methods used to arrive at estimates of soil loss and the portion attributable to several programs, in particular the Western Grain Transportation Act, CWB quotas, Western Grain Stabilization and farm fuel rebates.

Others, many outside the University of Alberta, also contributed in important ways to the project. Dr. V. Benson, of the Agricultural Research Service of the U.S. Department of Agriculture, was instrumental in providing access to the EPIC model. In company with several of his colleagues, he was gracious enough to field questions raised by neophyte EPIC users. Cesar Izaurraulde, University of Alberta, was helpful in several ways, particularly concerning operation of EPIC and in assisting access to relevant published material. E.W. Tyrchniewicz counselled on issues related to the study, and read and reacted to several sections of the report. G. Coen and J. Tajek, Agriculture Canada Soil Survey Unit, provided basic soils data and professional advice concerning land forms and soil characteristics. Colleagues in the Department of Rural Economy were sounding boards for issues as they developed, particularly W.L. Adamowicz, J.J. Richter, T.S. Veeman and W.E. Phillips. Members of the Steering Committee, R. Adam, M. Boyle, B. Colgan, S. Henderson, L. Fullen, L. Lyster, C. Ross and R. Wettlaufer provided useful comments both through formal meetings as well as directly to the study team, and also helped with data access. By no means least, Judy Boucher not only typed the document with customary skill and speed, but was also a useful critic of aspects of the report presentation.

Only the most senior authors are responsible for the errors and omissions which inevitably remain. We ask only the indulgence of readers in what we believe is a somewhat innovative approach to measuring and apportioning, to various public programs, the erosion associated them.

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EXECUTIVE SUMMARY

The study is an assessment of the manner and, to a more limited degree, the extent to which a number of programs have influenced on-farm land management decisions. This is approached initially through a questionnaire survey of grain farmers, asking them to respond to questions about land management practices in general, and the relationship of those practices to particular public programs. For those programs for which farmers appear influenced by decision-making based on program provisions, an assessment is made of the kind and degree of reactions which have taken place. The estimates relate to changes in cropping practices, changed input levels or altered tillage activities which have been undertaken in response to a particular target program.

A total of ten programs are reviewed. These include programs in three broad areas, Transportation and Marketing, Safety Net and Income Support, and Land Development and Assessment Programs:

Group I - Transportation and Marketing Programs:

1. Western Grain Transportation Act
2. Canadian Wheat Board Quota Policy

Group II - Safety Net and Income Support Programs:

3. Western Grain Stabilization Act
4. Farm Fuel Programs
5. Canada-Alberta Crop Insurance Program
6. Special Canadian Grains Program (SCGP)
7. Crop Drought Program

Group III - Land Development Programs and Assessment Procedures:

8. Land Clearing Programs
9. Drainage Programs
10. Municipal Farm Land Assessment Procedures

The study attempts to quantitatively link program/policy parameters to on-farm operational characteristics which, in turn, are quantitatively linked to soil degradation:

A		B		C
Policy or Program	-->	On-Farm Operational Characteristics	-->	Soil Degradation

The A-B and B-C linkages together constitute the A-C linkage, which is the focus of the study.

The primary task is developing a measure of the degree of erosion, and losses of topsoil are used as the indicator of soil loss. An attempt is also made to translate that cost into a measure of the on-site cost or productivity loss associated with that erosion.

Typical previous estimates of the cost of soil degradation have attempted to assess the difference between the current value of agricultural output and the value of agricultural output which would have been produced if soils exhibited the productivity of virgin land. That is, the productivity loss usually measured is the annual productivity loss which is due to all previous soil degradation since the land in question came into production.

For purposes of measuring program impacts, it is necessary to attempt a different measure of the cost of soil degradation, namely the degradation which takes place during a particular year. The degradation measured in this study is the degradation occurring in a particular year, t. The cost of the degradation is the reduction in net returns in year t as compared to year t-1, plus the discounted value of lost future production as a result of degradation occurring in year t.

Rigorously estimating productivity losses from soil loss estimates has only recently been developed using computer simulators. This study employs one such model. The computerized simulator used is known as EPIC, the Erosion-Productivity Impact Calculator, and is a product of attempts to measure changes in soil quality, including erosion, and productivity change. Developed for U.S. conditions, it has also been employed in a number of other locations, including Canada.

The Western Grain Transportation Act (WGTA)

The study employs recent estimates of the probable reaction of farmers to the elimination of the Western Grain Transportation Act. The probable effect of having had a changed method of payment of the Crow Benefit during the 1978-88 period is estimated to have been as follows: about 4 percent less wheat acreage, about 2 percent more barley acreage, an increase in oats acreage of 5 percent in the central region, and a major shift to canola (averaging 17 percent over the 11 year period). Significant changes in livestock production would have occurred during the period according to these estimates.

In general, the changed cropping patterns would have resulted in less erosion than would the current method of payment, as shown below:

	Future Simulated 50 Year Erosion (mm)		
Region	With WGTA	Post WGTA	Difference (mm)
Southern Alberta	30.3	23.3	7.0
Central Alberta (Black Soil)	20.4	18.4	2.0
Central Alberta (Gray Soil)	26.1	25.6	0.5
Peace River (Gray Soil)	31.3	30.1	1.2

Yield changes over a 50 year period are predicted to be slight, if any. With constant prices, aggregate gross returns per acre (and net returns per acre) are projected to remain relatively constant with or without the WGTA. Thus, the on-site costs of erosion of the magnitudes estimated do not appear to have an economic value during the 50 year horizon, to the degree the EPIC model has been able to estimate prospective yield changes in the four soil/climate profiles.

Canadian Wheat Board Quota Policy

The impacts of Canadian Wheat Board (CWB) quota on cropping behavior are likely to be highly variable from year to year, with effects only when grain deliveries are, or are expected to be, limiting. Thus, estimates of changes in cropping behavior due to CWB quotas are likely to be highly variable from year to year, and use of average estimates is unlikely to predict the effects of quota change in any particular year with accuracy. Nevertheless, estimates for the period 1976/77 to 1985/86 suggest the average annual effect of CWB quotas in Alberta was to decrease wheat area by 700,000 acres (283,000 hectares) and to increase barley area by 551,000 acres (223,000 hectares).

Farm survey responses suggest that livestock related production (forages but also barley) have been the major on-farm reaction to CWB quotas. The study uses the above data as well as survey responses as a basis for estimating that most (79 percent) of the acreage diverted to wheat has been planted to barley and that the remainder of diverted acreage is planted to forage crops. The estimated erosion due to CWB quotas in Alberta is shown below as the difference between expected 50-year erosion with and without CWB quotas, as those quotas influenced farmer behavior in the period 1976/77 to 1985/86.

Region	Future Simulated 50 Year Erosion (mm) With CWB Quotas	Without CWB Quotas	Difference (mm)
Southern Alberta	30.3	30.3	0
Central Alberta (Black Soil)	20.4	20.2	0.2
Central Alberta (Gray Soil)	26.1	27.0	-0.9
Peace River (Gray Soil)	31.3	28.7	2.6

Accordingly, the amount of soil erosion attributable to CWB quotas is estimated as very slight. The impact, if any, is most pronounced in the Peace River region.

No significant trend in gross returns per acre was estimated with or without CWB quotas. Accordingly, the changes in erosion due to the existence of quotas do not appear to impact soil productivity based on the degree of recent quota impact, and the farmer reactions to those quotas.

The Western Grain Stabilization Act

The Western Grain Stabilization Act (WGSA) was intended to be resource neutral. There is some belief that when grain prices fell sharply it may have had a tendency to keep farmers producing grain to qualify for program payouts, rather than switching to forages. However, when prices declined it may also have encouraged farmers to grow grains rather than fallow land, which can be viewed as assisting to maintain soil quality. The most likely effect of the program was to stimulate a slight increase in input use in each of the regions involved (more questionable in the Central Gray soil region). Evidence with respect to changes in cropping patterns is mixed, although the program may have slowed somewhat the change in production patterns from cereals (including wheat) to cash crops (such as canola) and perhaps forage.

The choice of the period for analysis of WGSA effects is especially important. Several large payouts were made in the later years of the 1980s, but payouts have not occurred in the last two (1988/89 and 1989/90) crop years. Consequently, the main current effect (aside from some risk-shifting) is likely the slight added cost involved in membership in the Western Grain Stabilization Program. The inference drawn in assessing program effects is therefore that the program has not influenced crop selection, but has, in the late 1980s at least, somewhat influenced input levels (primarily fertilizer use). This is consistent with previous analyses indicating small input increases or negligible overall effects. The effect which is simulated is a modest (10 percent) decrease in fertilizer use due in the absence of the WGSA.

The effects of the change are predictably slight. Yields do not change significantly, and topsoil loss, shown below, is not significantly affected. There may be a slight negative impact in the Peace River region due to removal of the WGSA.

Region	Future Simulated 50 Year Erosion (mm) With WGSA	Without WGSA	Difference (mm)
Southern Alberta	30.3	30.1	0.2
Central Alberta (Black Soil)	20.4	20.6	-0.2
Central Alberta (Gray Soil)	26.1	26.0	0.1
Peace River (Gray Soil)	31.3	30.6	0.7

Farm Fuel Programs

Fuel savings are possible with certain changes in farm practices, typically those associated in whole or in part with increasing farm sizes. Examples are carrying out multiple field operations in one pass, use of technology appropriate to multiple operations such as air-seeders, and shifts toward certain types of conservation tillage systems.

The types of impacts anticipated in the absence of fuel rebates would likely lead to an acceleration of on-going structural changes in farm size and technology. It is the size of this stimulus that is ambiguous.

To provide some indication of what impact the absence of fuel rebates would have on soil conservation in Alberta, it was assumed that one tillage operation would be eliminated. This was considered the most likely response based on follow-up telephone interviews with 20 randomly selected survey respondents. This change was then simulated utilizing EPIC to generate the results indicated below.

Region	Future Simulated 50 Year Erosion (mm) With Farm Fuel Rebates	Without Farm Fuel Rebates	Difference (mm)
Southern Alberta	30.3	29.8	0.5
Central Alberta (Black Soil)	20.4	14.4	6.0
Central Alberta (Gray Soil)	26.1	24.7	1.4
Peace River (Gray Soil)	31.3	26.6	4.7

In every region of the province, somewhat less erosion would likely occur in the absence of farm fuel rebates. The effect would be particularly pronounced in the Central Black and Peace River regions. The simulated saving would be as large as 6 mm. of topsoil over a 50 year period. This assessment places farm fuel rebates about on a par with provisions of the Western Grain Transportation Act as a contributor to soil degradation in the province.

At the same time, since no indication of a trend in yields was found, the study found no measurable on-site agricultural costs due to yield reductions over the 50-year simulation.

Canada-Alberta Crop Insurance Program

The Alberta Hail and Crop Insurance Program (AHCIP) has been in operation for almost 30 years. During its evolution, periodic criticism has focussed on land management issues associated with the AHCIP.

There is little evidence in this report to support the contention that the *present* Alberta Hail and Crop Insurance Plan (AHCIP) has had a major influence on the rate of agricultural land degradation in the province. Based on the survey responses of farmers who purchase crop insurance, only about one in five believes it actually affects the way he manages his land. Even with regard to neighboring land, only two of five farmers think the program has somehow affected land quality in their areas. The most frequently cited impacts are an increase in cultivated acreage and an increase in fertilizer and herbicide use.

The hypothesis that the AHCIP somehow inflates summerfallow acreage in Alberta is not supported by survey results. Based on this information, one can at least infer that the net province-wide impact on land degradation should be relatively small. Specific negative impacts appear to be region-specific and are apparently obscured by the level of aggregation considered in this report.

Follow-up telephone interviews with 20 randomly selected survey respondents closely paralleled the findings of the mail-out survey. Almost all of these farmers (who generally purchase crop insurance) also felt that crop insurance has little or no impact on their land management decisions. Similarly, the most frequent management response of farmers to the purchase of crop insurance is to increase either the quantity or quality of fertilizers and herbicides utilized in crop production; practices which should impede the rate of land degradation. Expansion onto more marginal land is rare, according to follow-up responses. Conversely, most farmers interviewed who do not purchase crop insurance cite abuse of the program by a small minority, say, five percent of insured producers. The reason stated most often is substituting crop insurance for fertilizer and herbicides, and the incentive for that may have disappeared with recent program changes. This perception implies a small but adverse long-term impact on land quality. The operative word in terms of the net province-wide impact is "small".

Special Canadian Grains Program (SCGP)

The SCGP existed only in 1987 and 1988, and in each year represented one-time direct income transfers to Alberta farmers. The payments were similar in amount.

Longer term management decisions are not generally based on short-term program initiatives. This is particularly true if program initiation was not foreseen, or if program continuation was not anticipated. While about 80 percent of survey respondents received SCGP payments, fewer than one-half expected the program to continue into a second year, and only about one-quarter reported an effect on management decisions. Typical adjustments (by the minority) included the use of more fertilizer/herbicides per acre, a slight expansion of cultivated (cropped) acreage, and a slight reduction in the acreage in summerfallow.

Estimates from EPIC simulations, which track the long-term (50-year) soil quality implications of slight temporary reductions in the summerfallow acreage (about 150,000 acres across the province), suggest a very small long-term impact. The estimated 50-year soil saving was assessed at about 0.15 percent. At the same time, if farmers' eventually expected a similar program to be implemented, say, every five years, the resulting impacts on soil quality would be magnified accordingly.

Information derived from follow-up telephone interviews with 20 randomly selected survey respondents also downplayed the potential impact of the SCGP on land use. Three quarters of these producers said it had no impact on their subsequent land management decisions. Only one farmer increased his land base (on to more marginal land), whereas two farmers reduced their summerfallow acreages, and one farmer shifted to more "qualifying" crops in the following crop year. In short, any identifiable impacts of the SCGP on farm decisions were likely short-term, and any province-wide impacts would be minor; muted by both the relatively small number of farmers who actually changed land management practices because of the program as well as the intensity of that reaction.

Canadian Crop Drought Assistance Program (CCDAP)

CCDAP recipients were concentrated in the south and southeast areas of the province. Payments based on 1988 experience were made in the summer of 1988. These one-time payments might be expected to have had very little effect on long-term decisions with respect to land use. This hypothesis is generally confirmed by both a quantitative overview and by information derived from the farm survey. Less than 20 percent of CCDAP recipients said they made any management adjustments in response to this program. The few conservation-oriented changes suggested (e.g. less tillage; less summerfallow) could also have been due either to the drought itself or the follow-up CCDAP.

A short-term reduction in summerfallow acreage in the South may have been the principal farm management response to the CCDAP. But EPIC simulations which mimic this change failed to indicate any significant long-term change to soil quality because of this probable short-term adjustment.

Information derived from follow-up telephone interviews with 20 randomly selected survey respondents similarly emphasized the small short-term impact the CCDAP might have had on land use. The vast majority (19 of 20), most of whom did not qualify for a payment, thought the CCDAP had no effect on their land management decisions.

Any identifiable impacts would have been concentrated in the brown soil zone. These potential region-specific impacts would have been small both because few producers apparently changed any management practices because of the CCDAP, and because such short-term adjustments as occurred were not major. In the brown soil zone, the CCDAP (or the drought itself) may have very slightly accelerated an on-going long-term trend towards less tillage and less summerfallow. Accelerated summerfallow reduction would (like the response to LIFT in the early 1970's) probably have a residual ever-diminishing impact for about five years. As such, the quantifiable long-term impact on soil conservation may have been very slightly positive but, using a 50-year time horizon, minute.

Land Management Programs

Both the farm survey and available secondary data indicate that former Crown Lands tend to be utilized in a less intensive manner than previously owned land, with more pasture/forage and less annual crop production/fallow on the former Crown lands. There are, however, soil quality impacts associated with changing ownership of Crown Land (most of which is either virgin land or unimproved pasture land). Such impacts occur almost by definition, because the rate of erosion on agricultural land exceeds that of uncultivated land. EPIC simulations were used to assess the different erosion rates likely on virgin versus cultivated land.

Based on a 50 year time horizon, and projected Crown Land sales of about 100,000 acres per year, additional erosion attributable to continued Crown Land sales is likely to augment on-going wind and water erosion in the province by 5 to 6 percent. Regionally, the percentages are under 5 percent in the South and Central Gray regions, and zero in the Central Black region. In the Peace River region, however, continued sales at the above rate could lead to erosion increases of about one-quarter over a 50 year horizon. These impacts are relatively severe vis-a-vis other programs considered herein. This does not in any way imply, however, that any major productivity (yield) or net economic costs will be incurred. These changes are still expected to be minor.

The only study evidence of the changing quality of former Crown Land is the farmers' own perception that nearly 90 percent of all farmers operating this land believe it is now at least as good as it was when it was initially purchased from the Crown. Conversely, over 10 percent feel it has deteriorated--particularly in the South and Peace River regions. Their assessment of the changing condition of former Crown Lands in their areas is generally similar, although nearly 30 percent of Peace River area respondents feel these lands have deteriorated since becoming privately owned.

Water Management Programs

The principal objective of most water management projects (exclusive of large-scale irrigation) is to control flooding and soil erosion and/or improve domestic, municipal or livestock water supplies. Only a small percentage of total program expenditures is allocated to agricultural land "drainage". Our province-wide EPIC simulations indicate that negative impacts on long-term soil quality are unlikely, and the net effect may be slightly positive.

Nearly all survey respondents report some advantages to various water management programs, while program effects are generally perceived to have had either a positive or neutral effect on the quality of agricultural land in their area. Subsequent telephone interviews with twenty randomly selected survey respondents elicited an equally positive response. On-going PFRA/Alberta Environment subsidies for water wells and dugouts were most frequently cited as being particularly beneficial to the farm community.

Program diversity and the multiple objectives of various relatively small water-related programs, however, precludes use of Province-wide simulations to assess the magnitude of this apparently positive net effect on soil conservation. The relatively small monetary cost of this program also tends to mute the impact at an aggregate level.

Municipal Farm Land Assessment Procedures

The current assessment rating system ranks a parcel of land in comparison with a predetermined area in the province that consistently produces the highest net income, over the long term, under typical management practices. The system incorporates the effect of soil quality, climate, physical features, and location.

There are two opposing views regarding the impact that farmland tax levels have on conservation practices undertaken by farmers. One view suggests that the reduced tax burden provides farmers with the financial assistance needed to compensate them for the increased costs they must incur to prevent, control or reverse soil degradation. This view suggests the current assessment system encourages conservation.

The opposite view is that lower taxes resulting from serious erosion or salinity serve as a financial incentive to practices that result in soil erosion or salinity. The system is therefore seen as inhibiting the adoption of soil conservation practices in Alberta. The present farm land assessment system provides a larger tax reduction to seriously degraded farm land as compared to the system used prior to 1984.

A small but statistically significant proportion of farmers view their own management decisions as having been affected by assessment procedures. The pattern of effects is difficult to assess, however. A majority of respondents cite no effect. Over three-quarters of respondents also cite no effect in their communities from the land assessment system, with a slight majority indicating a negative effect on area soil quality.

There appears to be no economic incentive for farmer to degrade soil in order to reap the benefits of lower tax rates. In principle, it might be expected that property tax assessments based on current land use would have a net positive impact on soil conservation. At the same time, since property taxes typically amount to only, say, 2 percent of total farm operating expenses, any measurable province-wide impacts (either positive or negative) are unlikely. Thus, while no property tax assessment system is likely to generate enthusiasm among those who must pay it, there is little evidence that measurable effects on soil quality have emerged. Accordingly, no estimates are made of the effect of the farm land assessment system on soil quality.

Program Summary

A general assessment of program impacts on soil erosion is as follows:

Programs with a relatively high impact on soil degradation: Western Grain Transportation Act, Farm Fuel Rebates, Crown Land Disposition.

Programs with a relatively low impact on soil degradation: Farm Land Assessment, short-lived programs such as SCGP, CCDAP.

Programs with a relatively neutral impact on soil degradation: WGSA, CWB Quotas, Crop Insurance.

Programs with a net positive impact on soil degradation: Water Management program(s).

In millions of tonnes during a 50 year simulation, soil losses by program are estimated as follows:

Program	Total Million Tonnes	Total Percent of Total Erosion
WGTA	418	14
WGSA	15	*
CWB Quotas	42	1
Fuel Rebates	346	12
Crop Insurance	*	
SCGP	(5)	*
CCDAP	(1)	*
Land	181	6
Water	6	*
Assessment	*	*
TOTAL[1]	1,002	32

[1] May not add due to rounding.

* Denotes negligible. (1) indicates soil formation.

The WGTA, Farm Fuel Rebates, and Crown land dispositions, according to this analysis, may account for almost one-third of all on-going soil erosion (as here defined) in the province. At the same time, the simulations consistently fail to suggest that the projected physical losses shown above would significantly reduce productivity (yield) levels or on-farm net income. This follows from the relatively low gross erosion losses predicted by EPIC and the assumption that relative costs and prices remain fixed over a 50 year period. The potential costs of (irreversible) gully erosion and off-site costs are not considered. Nor are the costs of other forms of degradation, such as organic matter loss or salinity increase. Within the context of this study, the prospect that erosion costs may be concentrated in certain specific areas could make the local impact considerably more severe than suggested by the broad aggregates used in this study.

1 INTRODUCTION AND NATURE OF THE PROBLEM

This study is an attempt to explore the interface between selected agricultural policies and soil conservation in the Province of Alberta. The issues with which the study deals are persistent ones: The degree to which specific programs influence the productive capacity of soils. The mechanism through which policy influences the productive capacity of soils is assumed to be encouragement of tillage practices or selection of crop rotations, or adoption of agricultural techniques which lead to more rapid degradation of future productive potential. These concerns have been raised by a number of commentators (for example, Bond et al. 1986, Mortenson et al. 1989, Pidgeon 1984, Prairie Farm Rehabilitation Administration 1987, Reichelderfer 1985), and reflect an established concern with soil conservation as it relates to soil productivity.

1.1 Study Objectives

The general objective of this study is to assess producer attitudes and provide a quantitative assessment of the extent to which select policies and programs influence the adoption of soil conservation practices in Alberta. With regard to each of the selected policies or programs, more specific objectives are the following:

1. Identify, through a review of relevant literature, and through a survey of farmers attitudes and views, the probable impacts on the adoption and use of good land management and soil conservation practices to prevent wind erosion, water erosion, salinization, and organic matter depletion;
2. Quantify the farm level impacts of the policies and programs identified in the study. This will include an analysis of the impact on farm cost structures and revenues resulting from each policy or program and of the extent to which the combined economic effects across all programs being studied detract from the farm level adoption of soil conserving measures in the main eco-regions of Alberta;
3. Identify potential adjustments to policies and programs that would reduce or eliminate any adverse impacts with regard to soil degradation, and
4. Identify data gaps and make recommendations regarding future data gathering activities.

In general, the study undertakes to assess the manner, and to the degree possible, the extent to which a number of programs have influenced on-farm land management decisions in a significant way. This is approached initially through a questionnaire survey of grain farmers, asking them to respond to questions about land management practices in general, and the relationship of those practices to particular public programs. For those programs for which farmers appear more than slightly influenced by decision-making based on program provisions, an assessment is made of the kind and degree of reactions which have taken place. The estimates relate to changes in cropping practices, changed input levels or altered tillage activities which have been undertaken in response to a particular target program.

1.2 Study Procedure

A producer survey, by region and farm type (especially grain versus livestock) was an integral component of this research in order: (a) to assist identifying linkages between policies and farm management activities; (b) to contribute to filling primary data gaps; (c) to obtain farmer input regarding research priorities for each policy/program; and (d) to serve as a partial "check" on the validity of research influences obtained by other means.

A mail survey of 5,000 producers was undertaken with close to 900 usable questionnaires received. Some additional telephone questioning of respondents also took place.

The questionnaire includes general information on degradation, information on reactions on each of ten selected programs, and a number of questions about the respondents' home farm operation.

In order to place these estimates into a common perspective, estimates are developed of the overall effects of the identified practices/rotations on output of grains and on the rate of soil loss, using a simulation model developed at the US Department of Agriculture. The result is an estimate of the extent to which selected programs influence farmer decision making, and an approximation of the on-site costs which are associated with soil degradation due to specific farm programs. Where possible, such evidence as is available is used to evaluate the quality of the inferences concerning on-site costs which flow from the use of the simulation model. Although the simulation results are based on a limited number of soil profiles, the results are a benchmark for the measurement of on-site costs of agricultural programs through their impacts on soil degradation, and illustrate at least general magnitudes of likely soil erosion effects.

2 SOIL DEGRADATION: CAUSES AND CONSEQUENCES

2.1 Introduction

There are numerous concerns and interests regarding soil degradation and soil conservation, including the esthetics of certain land forms, the productive value of the soil, and the impact of soil changes on other sites and on future choices. The aspect which motivates most studies of soil conservation or degradation is, however, concern for sustaining the on-site agricultural productivity of the soil.

This brief review focuses on how various researchers have tried to measure the causes and macro-consequences of erosion by wind and water, the principal and most widely recognized forms of soil degradation.[1] Some of the quantitative data generated by those earlier studies is also tabulated to help put the findings of the present study into context.

2.2 Physical Erosion Losses

Annual erosion losses depend on the complex interaction of soil, climate, and plant growth. Numerous hydrologic, weather, soil temperature, nutrient level, tillage, slope, texture, and plant growth characteristics must be considered. The Universal Soil Loss Equation (USLE), originally developed by researchers at the USDA (Wischmeier & Smith, 1978), illustrates the general nature of this interactive soil erosion process:

$$A = R.K.L.S.C.P.$$

where

A = erosion = tons of topsoil/acre/year

R = rainfall factor

K = soil erodibility factor

L = slope length factor

S = slope gradient factor

C = cropping and management, or cover factor

P = erosion control practice factor

The land management factors, C & P, emphasize the central role that management plays in this whole process: the type of ground cover maintained and exactly how a crop is grown are equally important. Generally, when a soil is increasingly disrupted (e.g. tillage) and/or increasingly little organic material (or other nutrient sources) is recycled, wind and water erosion increases. Recent estimates by Desjardins *et al* (1987) suggest that the annual erosion losses due to water in Alberta are highly dependent upon the type of ground cover maintained.

No Ground Cover (fallow)	24.9 tonnes/ha. (11 t./acre)
Cropland	4.9 tonnes/ha. (2.2 t./acre)
Forest	0.1 tonnes/ha. (0.045 t./acre)

Reference data for current average annual erosion losses for cropland in the U.S. border states is also suggestive (Kimberlin 1976, 345):

Washington	5.92 t./acre
Idaho	7.70 t./acre
Montana	8.78 t./acre
N. Dakota	5.33 t./acre
Minnesota	5.00 t./acre

1 For a discussion of other forms of soil degradation, see Appendix E.

Yet although some erosion characterizes virtually all soil, so too does regeneration and redeposition. It is the balance that is critical. Tolerable soil losses on cropland are defined as the maximum rate of annual soil erosion that will permit a high level of crop productivity to be sustained economically and indefinitely. And according to USDA studies, soil loss tolerances range from 1 to 11 metric tonnes per hectare (0.5 - 4.9 tonnes/acre) per year, depending upon the thickness of the A horizon (topsoil) and the existence of a favorable and sufficient rooting depth. Ten tonnes per acre per year represents the loss of about 1/10 inch of topsoil. But criteria for determining soil loss tolerances are constantly being debated and re-evaluated because it is very hard to generalize. For example, although cultivation increases rates of erosion, cultivation can also speed up the rate of soil formation by increased percolation and aeration of the upper horizons.

> "In uncultivated land, the natural weathering process can take as long as 300 years to produce 2.5 centimeters of ... topsoil ... Under cultivation, the process of soil formation can be much quicker. In some places, just three decades can build up 2.5 centimeters of topsoil, about 380 tonnes of topsoil per hectare. Some soils, however, gain at lesser rates, as low as 2.2 tonnes per hectare. In tonnages, the figures for the higher rate are impressive - more than 12 tonnes of topsoil being added each year to each hectare." (Fairbairn 1984, 16).

This latter figure is equivalent to some 5 tonnes/acre per year; very similar to acceptable T-value levels for soil loss established by the U.S. Soil Conservation Service for soils in that country.

More specifically, however, the T-value criterion has been criticized as a wasteful one because it ignores the issue of the timing of control measures. There is also a view that T-values have been too closely tied to the presumed rate of formation of the A horizon, not on additions to rooting depth, a slower process. T-values based on soil formation in the lower layers would therefore be smaller than those based on the A horizon, and the realization of such goals more expensive. Some effort has thus been made to separate the setting of T-values from the setting of soil conservation objectives. For example, T-values might be determined solely by the rate of formation of soil (perhaps based on the formation of a favorable rooting zone), while conservation objectives would reflect a range of other concerns, which might be ethical, economic or social concerns (Crosson with Stout, 4, 79-82).

Nevertheless, some attention has been given to the possibility of adapting a USLE and the T-value criterion to Alberta conditions, allowing that the frigid climate in the Prairie region is likely to alter the relationship between moisture and erosion which typically exists in more temperate regions. The concern is that barriers to water infiltration, while the lower horizons are frozen and the upper horizons are not frozen, can lead to greater erosion than would otherwise exist. Integrating previous work done to date on this issue, Tajek, Pettapiece and Toogood (1985) integrated these climatic characteristics into a modified USLE for Alberta.

Work on a USLE has focussed on water erosion, however, and other sources of erosion are also part of typical western Canadian conditions. In addition, USLE approaches carry the process of measuring the effects of erosion only part of the way. The USLE permits measuring the average annual soil loss as a function of a variety of climatic, topographic and management factors, but it does not provide a measure of the output consequences of that soil loss. To do so requires an additional component, akin to a production function in which soil depth or organic matter content is one of the variable inputs to the production surface.

In any event, conservationists argue that even if provincial average annual erosion rates are below the "tolerable" annual soil loss (however defined), there is still an urgent need for more and better and soil conservation because: (1) annual erosion losses are much higher in sub-regions within the province; (2) soil erosion may significantly increase the variability of production even though average productivity is not greatly affected; and (3) erosion is cumulative and sometimes irreversible; the productivity of some soils can be lost forever with moderate amounts of soil loss. The first point is a particularly compelling argument in Alberta where existing soil degradation and the risk of further degradation is relatively high: the south, central-east, and northwest (Table 2.1).

Table 2.1

Erosion - Summary of Risk, Extent and Ranking of Census Divisions in Alberta

Census Division (pre-1986)	Risk Class millions of acres Low	Moderate	High	% of Improved Land Eroded, 1984	Millions of Acres Eroded, 1984
1	--	.277	1.33	16.4	.264
2	--	1.17	1.40	13.2	.340
3	.197	.148	1.08	21.4	.304
4	--	.664	1.28	12.0	.233
5	1.43	.382	1.23	14.4	.438
6	1.11	.862	--	7.3	.144
7	--	--	2.99	16.2	.484
8	1.23	.128	.715	6.5	.135
9	--	.016	--	7.5	.001
10	.933	.329	2.33	9.5	.342
11	.326	.975	.788	12.9	.269
12	--	1.04	.140	96.	.113
13	--	1.41	.552	12.4	.243
14	--	.210	.009	8.2	.018
15	--	--	4.27	25.0	1.06
TOTAL					4.38

Source: Anderson, M., and L. Knapik. 1984. *Agricultural Land Degradation in Western Canada: A Physical and Economic Overview*. Ottawa: Regional Development Branch, Agriculture Canada, p. 48.

2.3 Productivity Cost Estimates

Erosion by wind and water removes part or all of the topsoil, and often the upper part of the subsoil, resulting in a soil with low organic matter, poor tilth, low water holding capacity, poor nutrient supply power, and lower capability for production.

Many of the estimates of the cumulative macro-economic costs of soil erosion in Canada (and the USA) are relatively large. One, by Sparrow *et al* (1984, 3, 111), is that soil degradation is "already costing Canadian farmers more than $1 billion per year in farm income." A major component of this loss is indicated to be the $239 million which the study estimates is needed to recover the yield loss due to wind and water erosion suffered by Prairie farmers. Fifty-eight percent of the cost is said to be due to wind erosion, with the remainder due to water erosion. Another estimate places the 1990 Alberta cost at $219 million annually, climbing by almost $2.0 million per year (Anderson and Knapik, 55). The cumulative annual per acre costs estimated by this study range from an average of $2.65 per cropped acre in Central Alberta to $14.27 in the Peace River region. Rennie (1986, 26-27) suggests the annual soil degradation cost exceeds $1 billion in the four western provinces.

An estimate of cumulative Prairie erosion costs due to water appears to be in the range of the fertilizer cost estimate suggested by Sparrow *et al* 1984. Based on the cost of replacing soil nutrients to maintain productivity lost through water erosion, (Desjardins *et al* 1986, 12) suggests that the cost of water erosion to Alberta farmers is $89 million annually.

These estimates however are all maximums in that they invariably assume the soil lost by erosion has been lost to agriculture as a result of the erosion which has taken place. That is, issues related to the destination of eroded soil are not considered. The net effect of the redeposition of soil on productivity would, by definition, be less than the gross loss as variously estimated (AAEA, 1986, 18; Crosson and Stout 1983, 39). It should also be noted that each of these estimates of the cost of soil degradation typically attempt to reflect the value of agricultural output which would have been produced if soils exhibited the productivity of virgin land. That is, the productivity loss which is being measured is the annual productivity loss which is due to all previous soil degradation since the land in question came into production.

The cost of soil degradation which takes place during a particular year is something quite different. The cost of the degradation occurring in year t is the reduction in net returns in year t as compared to year t-1, plus the discounted value of future production which does not take place as a result of degradation occurring in year t. One study which estimated the annual cost of degradation in Saskatchewan (Van Kooten *et al* 1989, esp. 70-72) suggests that the total discounted annual value of lost output on the Prairies due to soil degradation could be as low as $36 million. This translates into per-acre costs which range between $0.96 per acre and $2.28 per acre (Van Kooten, Weisensel and de Jong 1989, 72). In a comment on this article, Van Vuuren and Fox (1989, 551) argue that even these numbers may be unduly high and related Canada-U.S. research seems to support this assessment. For example, Ives and Shaykewich (1987) estimated yield changes for wheat in Manitoba following removal of different amounts of topsoil and found that removal of 5 cm. (50 mm) of topsoil from three soil types resulted in yield changes of -17, -17, and +2 percent respectively. This would represent an extremely high soil loss of about 200 tonnes/acre. Similarly, in the U.S., Calacicco *et al* (1989) simulated yields over 100 years using 1982 rates of erosion and found only slight yield reductions. For example, on the Northern (U.S.) Plains, aggregate yield reductions from erosion over 100 years were projected to decline only 1.1 percent for wheat and 0.2 percent for legume hay. Their conclusion is that "overall productivity losses caused by continued erosion will be small" (Calacicco, *et al*, 1989, 39).

Rigorously estimating productivity losses from soil loss estimates has only recently been developed using computer simulators. One such model is the SOILEC simulator which was developed at the University of Illinois (Eleveld *et al*, 1983) and more recently adapted to Ontario conditions by Fox and Dickson (1990, 23-44). This simulator translates erosion rates given by the Universal Soil Loss Equation (Wischmeier and Smith 1978) into reductions in soil productivity by estimating changes in the depth of soil horizons and changes in bulk density (see also Narayanan 1986). SOILEC uses linear interpolation to calculate the relationship between topsoil depth and variable costs of production as soil loss proceeds. The required physical data for the SOILEC model include topsoil depths, values of variables for the Universal Soil Loss Equation, rates of crop residue production, and soil bulk density. At the present time, however, it is not known how adaptable this model is to conditions in Alberta.

Another computerized simulator which has recently gained some currency is called EPIC, the Erosion-Productivity Impact Calculator (American Agricultural Economics Association Task Force 1986, 36-37). While the EPIC has been developed under U.S. conditions, fragmentary evidence (Izaurralde *et al* 1990) suggests the model is also reasonably suitable to Alberta conditions. It includes the option of a Universal Soil Loss Equation (USLE) which considers freeze-thaw effects, an apparent parallel to the freeze-thaw effects estimated by Tajek, Pettapiece and Toogood (1985). The rationale for employing this particular model in the present analysis is outlined in Chapter 3 immediately following.

Finally, one should note the interest, especially in U.S. studies (for example, Ribaudo 1986), in estimating the costs of degradation which occurs at points other than at the site where the degradation first occurred. Such off-site costs, usually found to be about twice as large as the on-site costs, include costs of silted waterways, flooding, damage to commercial fisheries, additional costs of water treatment for municipal or industrial use, and damage to agriculture through increased salinity. This line of research argues that the costs of on-site soil erosion/degradation are relatively small and, thus, that the costs of soil erosion should really be examined from an off-site cost perspective. This view is prominent in Fox and Dickson (1988, 23), Crosson (1986) and in Veeman, Adamowicz and Phillips (1989, 3).

2.4 Farm Management Linkages

A number of farming practices are repeatedly implicated in the decline in the quality of arable soils in Alberta and elsewhere, particularly (1) summerfallow and excess tillage; (2) poor crop management; and (3) the farming of fragile soils.

(1) **Summerfallow and Excess Tillage**

More than any other single farming or land management practice, summerfallow and excessive tillage have been shown to be responsible for much of the existing soil degradation. Wind erosion, water erosion, salinity, and organic matter decline occur primarily as a result of not maintaining a plant or plant residue cover on the soil at all times. Water body sedimentation and wildlife habitat losses also occur because of summerfallowing and excessive tillage.

(2) **Poor Crop Management**

Minimal seeding rates, poor quality seed, low levels of fertilizer application and poor weed control also contribute to soil degradation. As a result of low production levels, little crop residue remains after harvest. If the residue is not left on the surface of the soil, the field becomes highly susceptible to erosion from wind or water.

When cropland is poorly managed for a number of years in some areas of the province, the risk of salinization also increases and the organic matter content of the soil decreases.

(3) **Farming Fragile Soils**

Coarse-textured soils in areas subject to extensive wind such as the sandy soils in the chinook belt of southern Alberta, make certain lands extremely vulnerable to wind erosion. Similarly, farmland in the Peace River district incurs heavy soil losses from water erosion as a result of snowmelt and heavy rainfall on the more fragile soils and the long gentle slopes. Some of these areas of the province require special management to minimize degradation, especially if they are to remain in annual crop production. An example of a recommended practice is the use of forages or other perennial cover on steep slopes.

Many of these farm management deficiencies are linked in some way to the need to maintain ground cover, including crop residue, which keeps erosion at a minimum. Research indicates that crop residue levels should not drop below 1500 pounds per acre per annum.

There are still about 5 M. acres of fallow (which has little or no trash by the end of the season) in Alberta each year, largely in the S/SE and NW regions of the province. This soil is very susceptible to both wind and water erosion.

At the same time, both the number and type of tillage operation performed also greatly affect soil quality, as illustrated following:

Tillage Implement	% Trash Left Per Operation	% Left After 4 Operations
Wide Blade Cultivator	90	60-65
Cultivator + Low Crown Shovels	85	50-60
Cultivator + Normal Shovels	80	30-40
Cultivator + Harrows	60	10-15
Harrow-packer	80	30-40
Tandem or Offset Disc	50	5-15
Plough	10	--
Decay: Overwinter or Oversummer	80	--
Burning	0	--

Source: Canada-Alberta Soil Conservation Initiative.

Accompanying Table 2.2 is a chronological listing of the two dominant tillage technologies presently typical of each major agro-region in the province.

Table 2.2

Typical Regional Tillage Practices for Annual Crop Production in Alberta, 1990[a]

	Tillage Operations				
	"Conventional"		"Conservation"		Spring Start-Finish
Agro-Region	Pass	% Land	Pass	% Land	
Far South (Lethbridge)	1. Wide-blade cultivator (fall)		1. Air seeder with granular fertilizer (banding) and granular herbicide		
	2.(a) Cultivator (low crown shovels) with granular herbicide and anhydrous fertilizer (50% fall)		2. Air seeder + harrow-packer	40%	East: 15/4-15/5
	2.(b) As 2.(a) in spring (50%)	50%	OR		
	3. Hoe/disc press drill with fertilizer supplement		1. Cultivator (LCS) with granular herbicide and anhydrous fertilizer		West: 1/5-25/5
	4. Harrow-packer		2. Hoe/disc press drill with fertilizer supplement + harrow-packer	10%	
South (Airdrie)	1. Cultivator (LC shovels) (fall)		As 1. and 2. with air seeder option in Far South	50%	25/4-25/5
	2.(a) As 2(a) in Far South (fall)				
	2.(b) As 2(a) in spring	50%			
	3. Light cultivator (vibrashank)				
	4. As 3. in Far South				
	5. As 4. in Far South				
Central-South (Red Deer)	As 1. thru 5. in the South	60%	As 1. and 2. with air seeder option in the South and Far South	40%	25/4-25/5
East (Vermilion)	1.(a) Cultivator (LC shovels) with granular herbicide and anhydrous fertilizer (50% fall)		As 1. and 2. with air seeder option in Central South, South and Far South	50%	20/4-20/5
	1.(b) As 1.(a) in spring (50%)	50%			
	2. Light cultivator				
	3. Hoe/disc press drill with fertilizer supplement				
	4. Harrow-packer				

Continued . . .

Table 2.2 Continued . . .

Agro-Region	Tillage Operations: "Conventional" Pass	% Land	"Conservation" Pass	% Land	Spring Start-Finish
Central-North (Barrhead)	1. Cultivator (normal shovels) (fall) 2. Cultivator (normal shovels) with granular herbicide and anhydrous fertilizer (fall) 3. Cultivator (normal shovels) 4. Light cultivator (vibrashank) 5. Hoe/disc press drill with fertilizer supplement 6. Harrow-packer	85%	1. Cultivator (normal shovels) (fall) 2. Air seeder with granular fertilizer (banding) and granular herbicide 3. Air seeder + harrow-packer	15%	1/5-10/6
Far North (Fairview)	1. Cultivator (normal shovels) (fall) 2. Cultivator (normal shovels) 3. Cultivator (normal shovels) with granular herbicide and anhydrous fertilizer 4. Light cultivator (vibrashank) 5. Hoe/disc press drill with fertilizer supplement 6. Harrow-packer	60%	1. Cultivator (normal shovels (fall) 2. Cultivator/air seeder with granular fertilizer and granular herbicide 3. Air seeder/light cultivator (vibrashank) 4. Air seeder + harrow-packer	40%	South: 1/5-10/6 North: 10/5-15/6

[a] Most cultivators (excl. wide Nobel blades in the Far South) also have attached spring-tooth harrows. "Harrow-packers" often just mean "harrows" (60%) and these (with "conventional" tillage) are generally used either just before or just after seeding.

Source: Personal communications, regional Alberta Agriculture personnel, July 1990.

Progressively less fallow and tillage (frequency and kind) plus less crop residue removal would further reduce on-going soil erosion in the province.

Other conservation practices which maintain or enhance existing Alberta croplands include:

1. Improved crop rotations
   a. annual non-legume cash crops
   b. annual cereal and forages rotated
   c. perennial forage (range)
2. Increased use of inputs
   a. fertilizer and lime
   b. herbicides
   c. close seeded vs. row
3. Raising livestock, returning manure
4. Related conservation practices
   a. strip farming
   b. contour cultivation
   c. snow management
   d. shelter belts
   e. winter cover crops
   f. legume plowdown
   g. perennial crops on steep slopes

Finally, in a macro-context, continued expansion on to increasingly marginal (and increasingly fragile) cropland has (almost by definition) had a very negative impact on overall soil erosion rates in the province. This continued outward expansion on to forest land and native or improved pasture lands has usually amounted to about 100,000 acres per year during the last decade, primarily in the East and NW regions of the province. This represents an increase in the improved land base of about 0.3% per annum.

In summary, for an existing agricultural land base, soil erosion simulations must explicitly incorporate at least three management features into the estimation process: crop rotations (especially regarding summerfallow and forage crops), tillage (frequency and kind), and input levels. In a macro-context, the continued expansion on to increasingly marginal cropland must also be considered. It has been demonstrated that marginal lands can be farmed but require a high level of management to prevent soil degradation.[2]

2.5 Public Program Impacts

A brief literature review suggests that few analysts have attempted quantitative assessments of program impacts on land use or farm practices. By and large, there is a widely held view that certain programs have undesirable environmental consequences. Girt (1990) identifies the Western Grain Transportation Act, Western Grain Stabilization Act, Special Canadian Grains Program, Crop Insurance, policies of the Canadian Wheat Board, as well as certain marketing and production policies, as leading to less soil conservation or less habitat maintenance. Pidgeon (1984) also identifies a range of federal policies in the areas of transportation, marketing, insurance credit, taxation and income stabilization as having possible impacts on prairie soil and

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2 Local evidence of soil generation tends to support this point. For example, in the Rocky Mountain House area of Alberta, the soils have little or no topsoil under virgin conditions. However, farmers in this area tend to rotate oats with a clover crop every 2 or 3 years. Every third year the clover crop is plowed in. After a period of 30 years, there is a well developed upper horizon that is about 20 cm. thick and contains about 7-8 percent organic matter. The productivity of such a soil has clearly been increased by good management, indicating that soils can be generated/regenerated by appropriate management. (Personal communication).

moisture conservation. Similar concerns are raised about Canadian Wheat Board quotas by Prairie Farm Rehabilitation Administration (1987), about the same issue by Sahl *et al* (1989), and about crop insurance by the Crop Insurance Review Panel (1986) (especially Chapter 6). The judgements made regarding program effects in each of these studies are qualitative, however. The missing ingredient is typically the specific rotations and practices encouraged by particular programs, and the effect those practices/rotations have on the soil. Studies of this nature are also in their infancy in the U.S. Nevertheless, the identification of specific practices associated with public policy, and their impacts on soil conservation, is the central task confronting the authors of the present study.

3 STUDY METHODOLOGY

3.1 Introduction

From a methodological perspective, the central task is one of quantitatively linking program/policy parameters to on-farm operational characteristics which, in turn, must be quantitatively linked to soil degradation or depletion in Alberta agriculture:

A		B		C
Policy or Program	-->	On-Farm Operational Characteristics	-->	Soil Degradation

The A-B and B-C linkages are difficult to quantify. The A-C linkage is the focus of the proposed research.

In terms of both A-B and B-C linkages, the general methodology employed (for each policy/program is similar:

1. Review of relevant literature;
2. Producer survey of effects on producer practices and on perception of area effects;
3. Quantitative modelling; and
4. Aggregate assessment, including implications for further policy/research.

The specific activities conducted under each of these sub-headings will be unique to each of ten programs/policies being considered. The general *modus operandi*, however is based on questionnaire results (Section 3.2) and other approaches to the A-B linkage, and use of models appropriate to the B-C linkage (Section 3.3).

3.2 Questionnaire/Interviews

3.2.1 Design of Questionnaire

An important part of the soil conservation study is a producer survey intended to assess farmer attitudes concerning whether selected farm programs had affected land management practices which may have prevented or contributed to various forms of soil degradation.

A sample questionnaire is provided in Appendix C. The questionnaire is divided into three sections. Section I concerns information about soil degradation in the producer's area and on his own farm. Farmers were asked to identify the location of their farm by a map of agroecological resource areas supplied with the mail-out. These areas were later grouped into regions for comparison of survey responses.

Section II of the questionnaire concerns whether and how specific programs affected the farmer's management decisions, and to what extent farm practices and soil quality in the area have been affected. A brief program description is provided for each program.

Section III requests general information about the farmer's own farm operations.

3.2.1.1 Time of Mailing, Sample Methods and Response

A list of about 46,000 Alberta farmers holding Canadian Wheat Board (CWB) permits was obtained in March of 1990. From this list a systematic, random sample was chosen consisting of approximately 5,022 names and addresses, or about 10 to 11% of the sample frame. The 1986 census indicated there were 57,777 farms in Alberta. The farms selected by the above method for the survey were essentially grain and oilseed farms. A pretest of the questionnaire was done by individual interviews in late March. Eight of these responses were included among the survey response sample.

Questionnaires were mailed out in early April with a request that they be returned by late April if possible. Responses continued to be returned into May with a final cutoff date of early June in order to finalize a study sample. The total usable questionnaire returns was 891; a return rate of 17.6% for the questionnaires actually mailed out. The sample size of 891 responses was considered more than adequate, assuring that any given statistic would be within 3.28% of its real value at least 95% of the time.

3.2.2 Choice of Regions

The 26 agroecological resource areas were grouped into four regions on the basis of moisture restrictions, soil type, and general geographic location. The southern region included agroelogical resource areas A to K; the central black region areas L to O; the central gray region, areas P to S and Z (the mountain area); while the Peace River region included areas T to Y.[3] When a comparison was made with census data grouped similarly, census division 7 was divided equally between the central black region and the south region.

Table 3.1 compares the questionnaire response by region with an estimate of the total farms for that region derived from 1986 census data. This indicates that the highest response rates were from the South and Peace River regions.

Table 3.1

A Comparison of Questionnaire Returns by Region with 1986 Census Data of Farm Numbers by Region, Alberta

Region	Questionnaire Returns	Total Farms[a] (Census)	Sample Percentage
South	316	14,521	2.18
Central Black	334	24,486	1.36
Central Gray	108	10,513	1.03
Peace River	126	8,257	1.53
Total	891[b]	57,777	1.54

[a] The regional boundaries are indicated in Table 3.3.

[b] Includes responses which failed to include a coding for geographical location.

Table 3.2 gives an estimation of error for the survey statistics for the respective regions as determined by the size of the regional sub-sample. The error signifies that a given statistic for that region will lie within that percentage of the true statistic for the entire sample 95% of the time.

3 For a map of the agroecological resource areas, see Appendix G.

Table 3.2
Significance of Sample Size by Region

Region	Sample Size	Estimation of Error[a] (%)
South	316	5.51
Central Black	334	5.36
Central Gray	108	9.43
Peace River	126	8.73
All Regions	891	3.28

[a] The error signifies that 95% of the time a given statistic will lie within that percentage of the true value for the total sample.

Table 3.3
Land Use by Region Using the 1986 Census of Agriculture for Alberta

Region[a]	Crop Districts	Census Divisions
South	1, 2, (3), (4)	1 to 5, 1/2 of 7
Central Black	(3), (4), (5)	6, 8, 10, 11, 1/2 of 7
Central Gray	(5), 6	9, 12 to 16
Peace River	7	17 to 19

[a] Represent macro-agroecological resource areas.

3.2.3 Comparison of Producer Survey with 1986 Census of Agriculture for Alberta

The 1986 Census of Agriculture indicated there were 57,777 farms in Alberta whereas the producers selected for this survey came from a list of about 46,000 Canadian Wheat Board permit book holders residing in Alberta. Questions in Section III of the survey can be used to compare characteristics of the sample group of 891 producers with characteristics of the 1986 census group of producers.

The average farm size for the 1986 census farms was 883 acres, compared to 1199 acres for the survey group. Thus the survey farms were somewhat larger than the typical Alberta farm as might be expected since the survey was drawn from predominantly grain and oilseed producers. Of the respondents, 371 (41.6%) indicated their farms to be predominantly grain and oilseed farms, 463 (52%) indicated they had a mixed operation, 35 responses (3.9%) had a livestock operation, and 10 (1.1%) were primarily specialty crops farms. The remainder were in other types of farming (such as hay) or did not respond to this question. In the census 58% of farmers had cattle, which compares with 56% for the mixed and livestock farms in the survey. Nonetheless, the survey group appears to reflect a smaller portion (although probably only slightly smaller) of livestock producers than is the case for all Alberta farms.

While it is difficult to compare actual crops grown because the producer survey was recorded for 1989, three years after the census data, some general observations can be made. About 44% of the survey group's land was seeded to cereals or oilseeds compared to about 36% of land seeded to cereals or oilseeds in the census group. The survey group also had a higher percentage of land in summerfallow (13.5% compared to 10.3% for the census), and a higher percentage of land in other crops, hay, improved pasture and other uses (23.8% compared to 15.7% for the census). This would indicate that survey farmers were more established since the loss of the remainder of their farm land was unimproved (18.9% versus 37.5% of all farm land for the census). Moreover, of the survey group, 69.1% owned their land as compared to only 58.3% of the census farm group.

3.2.4 Extent of Soil Degradation Problems

Tables 3.4 to 3.7 summarize the responses to Section I of the questionnaire dealing with soil degradation on the respondent's own farm and in his/her community, as well as the change in the seriousness of degradation problems over the past ten years. Farmers from the south are the most convinced that soil degradation is a problem in their community (86.1%), with fewer (67.3%) indicating there was a problem on their own farms. Those responding that there are soil degradation problems in their communities outnumbered those responding negatively by a margin of two to one in all regions except the Central Gray region. In this region, "yes" responses (i.e., there is a problem) outnumbered "no" responses by a narrow margin. Those responding that there is a soil degradation problem on their own farm are in the majority for the province as a whole, but not for the Central Black and Gray regions.

- Wind erosion is viewed as the most common source of erosion, with 700 respondents (78.6%) reporting some degree of problem with this form of degradation in their community, and 497 (55.8%) reporting a wind erosion problem on their farm. This is most prevalent in the South with 32 respondents reporting a serious problem and 59 reporting a moderate problem on their own farm.

- Water erosion is the next most common, with 595 (66.8%) reporting a problem in their community and 461 (51.7%) reporting a problem on their own farm. In the Peace River region, 12 farmers (33.3% of the responses for the region) report water erosion is a serious problem and 30 (28.8%) report a moderate problem on their own farm. Water erosion in the Peace region is therefore seen as a moderate to serious problem by a larger proportion of farmers than in any other region, and the percentages exceed those in the South who view wind erosion as a moderate or serious problem.

- Soil salinity is reported to be the next most serious problem for farmers on their own farm. In the South, soil salinity is reported as a problem on the respondent's own farm by 65.5% of the farmers responding, making it almost as a severe a problem in that region as wind erosion. Salinity is regarded as a less significant problem in other regions.

- Organic matter loss was reported as a problem on the farmer's own farm most often in the Peace River region (54.8%), followed by the South (52.8%). Farmers in the Central Gray region report the least soil degradation problems of all farmers in all categories, including the acid soils category. Problems with acid soils are cited most often in the Peace River region, but less than half the farmers responded to this issue.

During the past 10 years, wind erosion is perceived by 54.2% of respondents as becoming more serious. This view was most widely held by farmers in the Central Gray region, where only 2 responses indicate wind erosion to be less serious compared to 57 responses suggesting it is more serious.

Water erosion is viewed as becoming more serious in the Peace River region, with respondents viewing it as more serious than wind erosion. Respondents from the South view water erosion as less of a problem than respondents from other regions.

Table 3.4

Is Soil Degradation a Problem in Your Community?

Number of Responses (%)

Type of Degradation	No Reply	Yes	No	Not Sure
In General				
South	13	261 (86.1)	22 (7.0)	20 (6.6)
Central Black	16	205 (64.5)	80 (25.2)	33 (10.4)
Central Gray	5	56 (54.4)	31 (30.1)	16 (15.5)
Peace River	5	74 (61.2)	27 (22.3)	20 (16.5)
All Regions[a]	39	600 (70.4)	163 (19.1)	89 (10.4)

Type of Degradation	No Reply	Slight	Moderate	Serious
Wind Erosion				
South	31	87 (30.5)	111 (35.1)	87 (27.5)
Central Black	81	133 (52.6)	88 (34.8)	32 (12.6)
Central Gray	38	50 (71.4)	16 (22.9)	4 (5.7)
Peace River	38	65 (73.9)	21 (23.9)	2 (2.3)
All Regions	191	337 (48.1)	237 (33.9)	126 (18.0)
Water Erosion				
South	117	143 (71.9)	51 (25.6)	5 (2.5)
Central Black	105	149 (65.1)	66 (28.8)	14 (6.1)
Central Gray	44	36 (56.3)	25 (39.1)	3 (4.7)
Peace River	27	43 (43.4)	41 (41.4)	15 (15.2)
All Regions	296	373 (62.7)	184 (30.9)	38 (6.4)
Soil Salinity				
South	67	110 (44.2)	102 (41.0)	37 (14.9)
Central Black	139	117 (60.0)	65 (33.3)	13 (6.7)
Central Gray	66	31 (73.8)	9 (21.4)	2 (4.8)
Peace River	56	55 (78.6)	10 (14.3)	5 (7.1)
All Regions	331	316 (56.4)	187 (33.4)	57 (10.2)
Organic Matter Loss				
South	102	73 (34.1)	96 (44.9)	45 (21.0)
Central Black	133	114 (56.7)	66 (32.8)	21 (10.4)
Central Gray	49	28 (47.5)	22 (37.3)	9 (15.3)
Peace River	34	41 (44.6)	34 (37.0)	17 (18.5)
All Regions	322	257 (45.2)	219 (38.5)	93 (16.3)
Acid Soils				
South	187	105 (81.4)	18 (14.0)	6 (4.7)
Central Black	187	105 (71.4)	32 (21.8)	10 (6.8)
Central Gray	65	30 (69.8)	12 (27.9)	1 (2.3)
Peace River	50	46 (60.5)	22 (28.9)	8 (10.5)
All Regions	493	287 (72.1)	86 (21.6)	25 (6.3)

[a] Data for all regions includes responses with no coding for location.

Source: Questionnaire responses.

Table 3.5

Is Soil Degradation a Problem on Your Farm?

Number of Responses (%)

Type of Degradation	No Reply	Yes	No	Not Sure
In General				
South	13	204 (67.3)	78 (25.7)	21 (6.9)
Central Black	28	141 (46.1)	143 (46.7)	22 (7.2)
Central Gray	4	43 (41.3)	53 (51.0)	8 (7.7)
Peace River	13	56 (49.6)	44 (38.9)	13 (11.5)
All Regions[a]	58	447 (53.7)	322 (38.7)	64 (7.7)

Type of Degradation	No Reply	Slight	Moderate	Serious
Wind Erosion				
South	96	129 (58.6)	59 (26.8)	32 (14.5)
Central Black	162	123 (71.5)	37 (21.5)	12 (7.0)
Central Gray	62	37 (80.4)	7 (15.2)	2 (1.9)
Peace River	69	43 (75.4)	10 (17.5)	4 (7.0)
All Regions	394	334 (67.2)	113 (22.7)	50 (10.1)
Water Erosion				
South	155	125 (77.6)	35 (21.7)	1 (0.6)
Central Black	171	128 (78.5)	26 (16.0)	9 (5.5)
Central Gray	56	34 (65.4)	15 (28.8)	3 (5.8)
Peace River	44	40 (48.8)	30 (36.6)	12 (14.6)
All Regions	430	330 (71.6)	106 (23.0)	25 (5.4)
Soil Salinity				
South	109	127 (61.4)	52 (25.1)	28 (13.5)
Central Black	200	97 (72.4)	27 (20.1)	10 (7.5)
Central Gray	78	23 (76.7)	6 (20.0)	1 (3.3)
Peace River	74	40 (76.9)	6 (11.5)	6 (11.5)
All Regions	464	291 (68.1)	91 (21.3)	45 (10.5)
Organic Matter Loss				
South	149	91 (54.5)	55 (32.9)	21 (12.6)
Central Black	202	94 (71.2)	33 (25.0)	5 (3.8)
Central Gray	66	28 (66.7)	11 (26.2)	3 (7.1)
Peace River	57	40 (58.0)	15 (21.7)	14 (20.3)
All Regions	480	254 (61.8)	114 (27.7)	43 (10.5)
Acid Soils				
South	214	89 (87.3)	8 (7.8)	5 (4.9)
Central Black	230	80 (76.9)	17 (16.3)	7 (6.7)
Central Gray	80	24 (85.7)	3 (10.7)	1 (3.6)
Peace River	69	39 (68.4)	12 (21.1)	6 (10.5)
All Regions	598	232 (79.2)	42 (14.3)	19 (6.5)

[a] Data for all regions includes responses with no coding for location.

Source: Questionnaire responses.

Table 3.6

Has Soil Degradation Become a More Serious Problem During the Last 10 Years in Your Community?

Number of Responses (%)

Type of Degradation	No Reply	More Serious	No Change	Less Serious
Wind Erosion				
South	33	163 (57.6)	80 (28.3)	40 (14.1)
Central Black	42	150 (51.4)	105 (36.0)	37 (12.7)
Central Gray	17	57 (62.6)	32 (35.2)	2 (2.2)
Peace River	18	50 (46.3)	43 (39.8)	15 (13.9)
All Regions	113	422 (54.2)	262 (33.7)	94 (12.1)
Water Erosion				
South	99	28 (12.9)	140 (64.5)	49 (22.6)
Central Black	75	72 (27.8)	147 (56.8)	40 (15.4)
Central Gray	24	28 (33.3)	45 (53.6)	11 (13.1)
Peace River	17	54 (49.5)	40 (36.7)	15 (13.8)
All Regions	219	184 (27.4)	373 (55.5)	115 (17.1)
Soil Salinity				
South	66	132 (52.8)	96 (38.4)	22 (8.8)
Central Black	105	92 (40.2)	121 (52.8)	16 (7.0)
Central Gray	36	15 (20.8)	52 (72.2)	5 (6.9)
Peace River	32	25 (26.6)	62 (66.0)	7 (7.4)
All Regions	243	265 (40.9)	333 (51.4)	50 (7.7)
Organic Matter Loss				
South	89	105 (46.3)	96 (42.3)	26 (11.5)
Central Black	90	111 (45.5)	101 (41.4)	32 (13.1)
Central Gray	25	43 (51.8)	35 (42.2)	5 (6.0)
Peace River	25	47 (46.5)	43 (42.6)	11 (10.9)
All Regions	234	308 (46.9)	275 (41.9)	74 (11.3)
Acid Soils				
South	153	26 (16.0)	114 (69.9)	23 (14.1)
Central Black	137	46 (23.4)	135 (68.5)	16 (8.1)
Central Gray	38	13 (18.6)	53 (75.7)	4 (5.7)
Peace River	35	26 (28.6)	57 (62.6)	8 (8.8)
All Regions	368	112 (21.4)	359 (68.6)	52 (9.9)

[a] Data for all regions includes responses with no coding for location.

Source: Questionnaire responses.

Table 3.7

Has Soil Degradation Become a More Serious Problem During the Last 10 Years on Your Farm?

Number of Responses (%)

Type of Degradation	No Reply	More Serious	No Change	Less Serious
Wind Erosion				
South	35	93 (33.1)	101 (35.9)	87 (31.0)
Central Black	50	68 (23.9)	144 (50.7)	72 (25.4)
Central Gray	24	28 (33.3)	46 (54.8)	10 (11.9)
Peace River	19	24 (22.4)	61 (57.0)	22 (20.6)
All Regions	130	214 (28.1)	354 (46.5)	193 (25.4)
Water Erosion				
South	93	17 (7.6)	131 (58.7)	75 (33.6)
Central Black	75	24 (9.3)	167 (64.5)	68 (26.3)
Central Gray	25	18 (21.7)	44 (53.0)	21 (25.3)
Peace River	17	34 (31.2)	54 (49.5)	21 (19.3)
All Regions	214	94 (13.9)	397 (58.6)	186 (27.5)
Soil Salinity				
South	72	81 (33.2)	115 (47.1)	48 (19.7)
Central Black	104	59 (25.7)	137 (59.6)	34 (14.8)
Central Gray	40	13 (19.1)	47 (69.1)	8 (11.8)
Peace River	34	10 (10.9)	67 (72.8)	15 (16.3)
All Regions	254	164 (25.7)	367 (57.6)	106 (16.6)
Organic Matter Loss				
South	96	60 (27.3)	98 (44.5)	62 (28.2)
Central Black	95	44 (18.4)	120 (50.2)	75 (31.4)
Central Gray	30	20 (25.6)	37 (47.4)	21 (26.9)
Peace River	24	26 (25.5)	46 (45.1)	30 (29.4)
All Regions	250	151 (23.6)	302 (47.1)	188 (29.3)
Acid Soils				
South	159	17 (10.8)	108 (68.8)	32 (20.4)
Central Black	134	30 (15.0)	140 (70.0)	30 (15.0)
Central Gray	37	9 (12.7)	51 (71.8)	11 (15.5)
Peace River	32	14 (14.9)	68 (72.3)	12 (12.8)
All Regions	366	71 (13.5)	368 (70.1)	86 (16.4)

[a] Data for all regions includes responses with no coding for location.

Source: Questionnaire responses.

Six times the number of farmers in the South region cited soil salinity as a more serious problem in the last ten years compared to those who cited it as a less serious problem. Fewer farmers, however, report soil salinity to be a more serious problem on their own farms.

Finally, four times as many farmers perceive organic matter loss to be a more serious problem in their communities over the past 10 years compared to those who perceived it to be less of a problem, but the majority of farmers in all areas believe it to be less of a problem on their own farms. Acid soils are not considered to be significantly more serious in the South either for the community or on their own farm, but farmers in the Peace River reported this to be a more serious problem both on their own farms and in their communities.

3.2.5 Changes in Farm Operations

Tables 3.8 to 3.11 show the changes in respondent's farm operations which may have some effect on soil degradation.

While 27% of respondents have cleared new land and 17% have cultivated native pasture, this was balanced by 34% of respondents who had reseeded cultivated land to pasture or forage. The mean acreage reseeded is 203 acres, compare to the mean acreage cleared of 83 acres and mean area of pasture broken of 118 acres.

An increase in cultivated acreage due to drainage is reported by 16% of respondents. The mean area drained is 78 acres (for those who drained land), which is largest per farm in the Peace River region. Only 8% of farmers in the South region drained land compared to 19% in the central regions and 27% in the Peace River group. Central region respondents drained an average of 46 to 47 acres per farm, compared to 63 acres per farm in the Southern region. Farms in the Peace River reported a mean drained area of 168 acres per farm (reporting drainage).

Overall, the regions' farmers report a net decrease in summerfallow (38.1% of respondents compared to only 11.7% reporting an increase), an increase in cereal and oilseed acreage, and a net increase in hay and improved pasture as well.

Regarding crop residue, more farmers report a decrease in the amount of residue burned, an increase in the amount of residue left on or in the field, and a decrease in the amount of residue removed from the field or sold.

Respondents also report a decrease in conventional fallow and an increase in the use of minimum tillage and zero tillage. For input uses per cropped acre, 49% report an increase in the use of fertilizers and pesticides, while 48% report increases for fuel and irrigation. A majority of farmers report a decrease in the number of tillage operations (spring and fall).

A large number of farmers report an increase in cattle numbers, but also report a decrease in hog and poultry numbers.

Table 3.10 gives the mean number of years indicated by farmers in 10 year rotations for the 1970's and 1980's of wheat, oilseeds, cereals, forages, and summerfallow. While the wording of this question led to an underestimation of the land in oilseeds, and a probable overestimate of the land in fallow, the directions of change are still relevant. In all regions except Peace River, there appears to be a decrease in wheat acreage in rotations. Barley and other cereal grains have increased in the South and Central Gray areas (about the same in the Central Black), while decreasing in the Peace River. Oilseed and forage acreage have increased in rotations in all regions.

Table 3.11 compares some of the various estimates of the fraction of land in summerfallow. These estimates were obtained from three questions within the survey: the actual 1989 land usage; the changes in rotation; and the changes in summerfallow. The actual fallow in 1989 for the South may have been higher than normal due to drought. There does, however, appear to have been a reduction in fallow in all regions.

Table 3.8

Changes in Farm Operations in Past Ten Years

Number of Responses (%)

	Increase	No Change	Decrease	No Response
B. Changes in Land Use of Cultivated Land				
Summerfallow	90 (11.7)	388 (50.3)	244 (38.1)	119
Cereals/oilseeds	237 (31.5)	416 (55.3)	99 (13.2)	139
Hay/improved pasture	290 (41.8)	332 (47.8)	72 (10.4)	197
C. Changes in Crop Residue Management				
Amount burned	5 (1.1)	289 (66.1)	143 (32.7)	454
Left on or in field	318 (38.8)	477 (58.2)	24 (2.9)	72
Remove	76 (12.9)	382 (65.1)	129 (22.0)	304
D. Changes in Type of Summerfallow				
Conventional	36 (5.4)	444 (66.1)	192 (28.6)	219
Minimum tillage	199 (37.3)	307 (57.5)	28 (5.2)	357
Zero tillage	96 (21.6)	323 (72.6)	26 (5.8)	446
E. Changes in Input Use Per Cropped Acre				
Fertilizer use	406 (49.0)	307 (37.1)	115 (13.9)	63
Pesticides	398 (48.0)	350 (42.2)	82 (9.9)	61
Fuel use	232 (27.6)	447 (53.2)	162 (19.3)	50
Irrigation	53 (11.8)	383 (84.9)	15 (3.3)	440
F. Changes in Pre-Seeding Tillage Operations				
No. of operations (fall & spring)	96 (11.3)	518 (60.9)	237 (27.8)	40
No. of operations burying residues	91 (11.6)	483 (61.4)	213 (27.1)	104
I. Changes in Livestock				
Cattle	295 (46.2)	231 (36.1)	113 (17.7)	252
Poultry/hogs	55 (15.9)	205 (59.4)	85 (24.6)	546

Source: Questionnaire responses.

Table 3.9

Changes in Cultivated Acreage

Mean Acres Per Farm Responding (Number of Responses)

	South	Central Black	Central Gray	Peace River	Alberta
Brush/clearing	163.2 (22)	46.5 (112)	75.3 (43)	126.3 (63)	82.8 (242)
Breaking of native pasture	208.5 (56)	55.3 (62)	59.4 (19)	127.7 (11)	117.5 (150)
Re-seeding to pasture or forage	199.1 (82)	119.1 (126)	389.0 (51)	245.1 (39)	203.4 (299)
Drainage	62.5 (24)	46.3 (63)	46.9 (21)	168.1 (34)	77.8 (143)
Total responses for region	(316)	(335)	(108)	(126)	(891)[a]

[a] Totals will differ by responses with uncoded location and by the number of non-respondents.

Source: Questionnaire responses.

Table 3.10

Mean Number of Years of Wheat, Oilseeds, Feedgrains, Forage, and Summerfallow in 10 Year Rotation as Indicated by Farmers in Survey by Regions

1970's	South	Central Black	Central Gray Luvisolic	Peace River
Wheat	4.256	2.430	1.327	2.672
Oilseeds	.167	.611	.460	.700
Feedgrains	1.471	4.111	4.455	3.401
Forages	.243	.763	2.107	.888
Summerfallow	3.863	2.085	1.650	2.339

1980's	South	Central Black	Central Gray Luvisolic	Peace River
Wheat	3.746	2.203	1.135	2.702
Oilseeds	.345	.958	.550	1.080
Feedgrains	2.323	4.090	4.691	3.130
Forages	.524	1.245	2.301	1.422
Summerfallow	3.062	1.504	1.323	1.666

Source: Questionnaire responses.

Table 3.11

Comparison of Estimates of Proportion of Land in Summerfallow by Survey and by 1986 Census[a]

	South	Central Black	Central Gray	Peace River	Alberta
1986 Census	.1343	.0721	.0495	.1214	.1030
1989 Survey (actual)[b]	.1935	.0653	.0504	.0852	.1353
Changes in Summerfallow[c]					
Average 1970's	.3331	.1892	.1589	.1686	.2609
Average 1980's	.2711	.1455	.1234	.1195	.2074
Changes in Rotation[d]					
Average 1970's	.3863	.2085	.1650	.2339	.3044
Average 1980's	.3062	.1504	.1323	.1666	.2050

[a] All estimates express land in summerfallow as a fraction of total farm land or land in a specific crop rotation.

[b] Question III.2 of survey.

[c] Question III.5.H of survey.

[d] Question III.5.G of survey.

3.3 THE EPIC MODEL

The EPIC model is outlined in detail elsewhere (Williams, Jones and Dyke 1989). Briefly, the model is able to predict yield and other consequences of wind erosion, using a model focussed on that source of degradation, as well as to assess the consequences of water erosion based on a variant of a Universal Soil Loss Equation (USLE). Such other sources of soil degradation as salinization are excluded, although wind and water aspects of degradation under irrigation appear capable of being dealt with in the model. In order to bring degradation to a yield measurement, EPIC includes a crop growth model in which yield for a range of crops is a reflection of the most limiting of five "stress" factors: water, temperature, nitrogen, phosphorus, and aeration (Williams, Jones and Dyke 1989, 55-64, 69-71).

The initial concerns which led to development of the EPIC model were clearly concerns with respect to long-run productivity of the soil (Benson *et al* 1989, 600). In addition, developers of the model wanted to develop an approach to estimating productivity loss over long periods of time which would be consistent with their view of long term sustainability, largely represented as undiscounted future returns.

The EPIC model is the outcome of an effort to provide a framework within which policy makers can be presented with a quantitative and reasonably objective assessment of the impacts on productivity of alternative conservation practices, and to permit drawing those assumptions under a wide range of physical and biological assumptions concerning soil, weather and cropping conditions. The model is

> "... a computer simulation model developed to assess the impact of soil erosion on crop productivity. It simulates the interaction of climate, soil, and plant growth by linking state-of-the-art algorithms describing plant growth management processes. The model has nine sectors or submodels: hydrology, weather, erosion, nutrients, plant growth, soil temperature, tillage, economics, and plant environment control" (Benson *et al* 1989, 601).

The model estimates the sheet and rill components of water erosion and wind erosion. It does not estimate gully or ephemeral gully erosion. To the extent these exist, it may understate erosion prospects. Neither does it consider soil regeneration, however. To the extent that regeneration (Benson *et al* 1989, 601) or redeposition occur, the model is likely to overstate the rate of erosion, and hence the costs associated with loss of productivity on a particular site.

The function of the model in the current study is to assist in drawing a relationship between farm practices, including cropping patterns and management practices generally, and soil degradation. It then permits an estimate of the degree of yield loss which occurs as a result of the soil degradation which has taken place. The outcome is a production surface in which soil characteristics, including the level or slope of the surface, influence the level of output estimated by the production surface. The model therefore simulates crop production processes, with soil quality as an independent variable, making the EPIC model a potentially valuable tool in assessing the changes in crop production due to soil degradation.

The EPIC Model permits carrying out an allocation of the erosive effects associated with particular practices, and therefore provides a basis for assessment of programs which encourage/discourage adoption of these farm practices. A concern with use of the model has been its focus on U.S. conditions, and the lack of certainty concerning its ability to simulate cropping conditions and soil changes elsewhere in the world. However, the model has been employed under Alberta conditions, with reasonably satisfactory performance predicting yields (Izaurralde *et al* 1990). A major test of the model in the south of France indicated that the model "can simulate yields of summer crops grown in complex rotations in southern France with accuracy acceptable for many applications" (Cabelguenne *et al* 1990, 153). It has, of course, been extensively used under a wide range of soil, climatic and topographic conditions in the U.S.

4 PROGRAM DESCRIPTION AND EFFECTS

Ten programs with respect to agriculture were selected for closer scrutiny. These programs include several prominent programs which are believed to influence farmer decisions. This section of the report provides a description of the program and its operation, and review of the reactions of farmers (via the mail questionnaire), and an outline of perceived effects as seen by (1) modeling of responses, and (2) further questions and comments by farmers in cases where those were sought.

In addition, where possible, the results of modeling of cropping changes, and the assessment of their effect on soils productivities were assessed using the Erosion Productivity Impact Calculator (EPIC).

4.1 The Western Grain Transportation Act (WGTA)

4.1.1 Background

The Western Grain Transportation Act, passed in November of 1983, has as its goal maintaining and improving the rail system for shipments of Western Canadian grain. The passage of the WGTA was an historic landmark for grain transportation, as the Act replaced the Crowsnest Pass rates for shipment of export grains, rates which had become a fixture of Canadian grains policy.

The Crow Rates were reduced rail freight rates for grain and flour dating back to the Crowsnest Pass Agreement of 1897. This agreement was signed between the Canadian Pacific Railway and the federal government. In exchange for various concessions, primarily a federal subsidy to construct a rail line through the Crowsnest Pass into southern British Columbia, the railway agreed to maintain lower freight rates for grain and flour in perpetuity.

Initially rates applied only on certain railway points, and rates were often less than the maximum rate specified. In a court case of 1925 (Kulshreshtha and Devine 1976), the Supreme Court upheld the railway interpretation that rates applied only on rail lines existing prior to the agreement. The court also clarified the agreement as existing between the railways and the government, and not as an obligation by either party to Western farmers. However, the federal government passed further legislation in 1925 to extend the Crowsnest Pass rates to all grain shipped from the prairies from all rail lines to eastern Canada (Thunder Bay and other specific destinations), to Churchill, and to Pacific ports. Prior to this, shipments to the west coast had not been covered. Also, the earlier commitment by the railways to reduce the freight cost on various goods shipped to the Prairie region was removed.

By the early 1970's, the government and western grain industry were faced with additional problems. The shortfalls in rail revenue were a disincentive for rail service or replacement of rolling stock. Federal and provincial governments, and the Canadian Wheat Board, purchased hopper cars for use in grain shipment. Railways attempted to abandon branch lines with insufficient traffic, which prompted protests from farmers about added costs of grain delivery and from local citizens about survival of small towns. It was during this period that the term 'Crow Benefit' came into use. The Crow Benefit came to be defined as the difference between what farmers were paying for grain transportation (by rail for export or for easterly movement) and the full costs of grain shipment. Defining realistic railway costs became a major task in itself.

As the 1980s began, the Canadian government concluded that it would be necessary to alter the Crow rates. The decision taken was to pay higher rates to the railroads without immediately burdening farmers with markedly higher freight rates. This was done by provisions of the Western Grain Transportation Act of 1983 (WGTA). The most important decision within the WGTA was that of the method of payment of the Crow Benefit. The WGTA provided a major new federal subsidy, the Crow Benefit, which could be paid to the railways or directly to producers. The final decision was to make the payment to the railways. The WGTA did, however, provide for review mechanisms by which the method of payment issue and an overall review of the WGTA could be addressed at a later time.

By making export crops relatively attractive, the Crow rate is alleged to have encouraged producers to grow export grain rather than other crops not generally sold into the export market.[4] Livestock feeders, millers, and oilseed crushers paid higher prices for grain and oilseeds than would have been the case if the freight rates had been higher. Moreover, the Crow Rate applied to rapeseed destined for export or Eastern Canadian markets, but not for meal and oil products. This made it difficult for crushers to sell meal and oil for export, or into eastern Canada where canola oil and meal competed with soybean oil and meal. While the WGTA extended the freight subsidy to oil and meal travelling east and for export, correcting to some degree the distortion for canola crushers, the payment of the subsidy to railways rather than producers did not resolve the concerns of the livestock industry.

4.1.2 Operation of the WGTA

Once the annual government contribution to the WGTA is set, and an estimate is made of the quantity likely to be shipped in the coming year, the government contribution per tonne shipped is calculated. The government is responsible for this amount irrespective of how much grain is shipped.

Table 4.1.1 lists the government payments to date under the WGTA. The annual government contribution varies considerably depending on the amount of grain actually shipped. The payment was $501.6 million in the 1984/85 crop year, rising to $835.9 million in 1987/88. The annual expenditure varies considerably with shipments during a year.

Table 4.1.1

Federal Payments - Western Grain Transportation Act
($000)

August to July	1984/85	1985/86	1986/87	1987/88
Payments	$501,619	$630,795	$906,087	$835,887
Gov't Share of Total Freight Cost	n.a.	78.6%	80.7%	72.7%

Source: Canadian Transport Commission. Annual Reports. 1984 to 1987; National Transportation Agency of Canada. Annual Report. 1989 (tables readjusted for tabulation by crop year). The government share of total freight costs is from Alberta Agriculture. Statutory Freight Rates, various years.

Total freight rates are calculated as a multiple of a base rate scale which is a schedule of distance-related rates. The WGTA formula determines the factor by which the base rate scale is multiplied. The government share is calculated as a percentage of the total freight cost and the farmer's rate is the difference when the government share is deducted from the total freight rate.

In 1987/88, the federal government contributed $64 million in addition to contributions required by the WGTA. This contribution reduced producer freight costs during that year by about $2/tonne. In 1988/89, the federal government contributed an additional $35 million, which reduced the producer's share of freight costs by $1.11/tonne. The government share of total freight costs in 1988/89 was 76% (including both WGTA and special contributions). The percentage has fallen to 70.3% in 1989/90 as the producer continues to bear a larger portion of the costs.

4 Much has been written about the likely impact of changes in grain transportation rates, including recent quantitative studies by Alberta Agriculture and Alberta Wheat Pool (1989) and by Dunlop (1989). The studies have attempted to measure the extent of impacts, but few have doubted the direction of those effects, viz: "The Crow Rate/Western Grain Transportation Act (WGTA) have consistently pushed Prairie land use in a single direction, encouraging annual cultivation and the production of grain, especially wheat for export, at the expense of most other types of agricultural production." (Rosaasen, Eley and Lokken 1990, 1-2).

4.1.3 Survey Responses

Table 4.1.2 indicates that approximately one-third of farmers believed that the existence of the Western Grain Transportation Act had in some way affected business decisions on their own farms. Among those business decisions which were influenced by the WGTA, prominent ones include (Table 4.1.3) more cultivated acreage, more forage area, more inputs per acre, and added livestock. Some tendency toward less fallow and fewer tillage operations (perhaps related) was also expressed. Comments made by some respondents suggested, however, that not all farmers viewed the WGTA as separate from Alberta Government programs designed to offset the impact of the WGTA on grain and livestock production. The result may be that some of the response concerning effects, particularly concerning livestock and forage production, and perhaps also concerning fallow acreage and tillage practices, may reflect not only the WGTA but also programs designed to offset the effects of the WGTA on livestock and feedgrain production.

Table 4.1.2

Farmers' Responses Concerning the Effects of the WGTA on Their Own Farm Operations

	Number of Responses (% of Those Responding)				
WGTA Affect or Not	South	Central Black	Central Gray	Peace River	All Regions
Yes	101 (32.9)	111 (33.7)	39 (36.1)	47 (38.2)	300 (34.3)
No	206 (67.1)	218 (66.3)	69 (63.9)	76 (61.8)	574 (65.7)
No Response	9	5	0	3	17
Total	316	334	108	126	891

Source: Questionnaire responses.

Table 4.1.3
Effect of the WGTA on Farmers' Own Operations in the 1980's

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	219	25 (25.8)	64 (66.0)	8 (8.2)
Summerfallow acreage	223	5 (5.4)	55 (59.1)	33 (35.5)
Forage acreage	222	37 (39.4)	42 (44.7)	15 (16.0)
Inputs per acre	219	41 (42.3)	32 (33.0)	24 (24.7)
Tillage operations	222	12 (12.8)	51 (54.3)	31 (33.0)
Livestock production	220	42 (43.8)	41 (42.7)	13 (13.5)

Region - Central Black	Number of Responses (% of Those Responding)			
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	239	30 (31.6)	47 (49.5)	18 (18.9)
Summerfallow acreage	236	14 (14.3)	50 (51.0)	34 (34.7)
Forage acreage	233	48 (47.5)	28 (27.7)	25 (24.8)
Inputs per acre	233	40 (39.6)	37 (36.6)	25 (24.8)
Tillage operations	240	13 (13.8)	52 (55.3)	29 (30.9)
Livestock production	229	50 (47.6)	31 (29.5)	24 (22.9)

Region - Central Gray	Number of Responses (% of Those Responding)			
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	71	13 (35.1)	14 (37.8)	10 (27.0)
Summerfallow acreage	70	6 (15.8)	23 (60.5)	9 (23.7)
Forage acreage	73	25 (71.4)	3 (8.6)	7 (20.0)
Inputs per acre	72	11 (30.6)	13 (36.1)	12 (33.3)
Tillage operations	72	4 (11.1)	23 (63.9)	9 (25.0)
Livestock production	74	22 (64.7)	7 (20.6)	5 (14.7)

Region - Peace River	Number of Responses (% of Those Responding)			
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	80	12 (26.1)	28 (60.9)	6 (13.0)
Summerfallow acreage	81	9 (20.0)	19 (42.2)	17 (37.8)
Forage acreage	79	22 (46.8)	17 (36.2)	8 (17.0)
Inputs per acre	80	19 (41.3)	15 (32.6)	12 (26.1)
Tillage operations	80	6 (13.0)	25 (54.3)	15 (32.6)
Livestock production	88	14 (36.8)	16 (42.1)	8 (21.1)

Province Summary	Number of Responses (% of Those Responding)			
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	609	80 (29.1)	153 (55.6)	42 (15.3)
Summerfallow acreage	610	34 (12.4)	147 (53.6)	93 (33.9)
Forage acreage	607	132 (47.7)	90 (32.5)	55 (19.9)
Inputs per acre	604	111 (39.5)	97 (34.5)	73 (26.0)
Tillage operations	614	35 (13.0)	151 (55.9)	84 (31.1)
Livestock production	611	128 (46.9)	95 (34.8)	50 (18.3)

Source: Questionnaire responses.

Table 4.1.4 provides responses of farmers concerning effects of the WGTA on quality of agricultural land in their areas. Two-thirds to three-quarters apparently believe it had no effect. The number who saw negative effects exceeded those who saw the WGTA aiding soil quality (163 to 85), but the majority of those who saw effects indicated that those were likely to be slight, whether positive or negative.

Table 4.1.4

Farmers' Estimates of Effects of the WGTA on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
- 3	16 (5.5)	14 (4.5)	0 (0.0)	2 (1.7)	32
- 2	8 (2.7)	25 (8.1)	4 (4.0)	11 (9.5)	48
- 1	20 (6.9)	39 (12.6)	9 (9.1)	13 (11.2)	83
No Effect	216 (74.2)	204 (66.0)	69 (69.7)	81 (69.8)	573
+ 1	20 (6.9)	15 (4.9)	7 (7.1)	4 (3.4)	47
+ 2	6 (2.1)	5 (1.6)	6 (6.1)	3 (2.6)	20
+ 3	5 (1.7)	7 (2.3)	4 (4.0)	2 (1.7)	18
Strongly Positive					
No Response	25	25	9	10	70
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.1.4 Farm Management Impacts

4.1.4.1 Cropping Patterns

The probable reaction of farmers to the elimination of the Western Grain Transportation Act have been studied in a number of ways. These reactions include studies by Harvey, Agriculture Canada, and a number of studies in Western Canada, including Dunlop 1989 and a series of analyses by the Alberta Government which undertook to assess aspects of cropping patterns and farm output changes due to the changed grain/livestock price patterns associated with the WGTA.

As a result, it is possible to obtain estimates of changes in farm production and some aspects of other practices from sources in addition to survey responses in this study. One aspect of those changes is shown in Table 4.1.5. Derived from analysis of the impact of changing to a producer method of payment, the table indicates that overall in the Province during the simulated period (1978-88), removal of the Crow Benefit would have led to about 4 percent less wheat production, about 2 percent more barley output, an increase in oats production of 5 percent in the central region, and a major shift to canola (averaging 17 percent over the 11 year period). While not shown, the acreages unaccounted for represent fallow, forages or other crops not indicated in the table. Significant changes in livestock production, not shown here, would have occurred over the period according to these estimates (Alberta Agriculture and Alberta Wheat Pool 1989).

Table 4.1.5
Simulated Annual Change in Crop Production Without the WGTA (Crow Benefit), by Region (Base Data = 1978-88)

Crop	South	Central Black	Central Gray	Peace River	Total
Wheat	3.50%	-14.71%	-24.81%	-7.25%	-4.34%
Barley	13.56%	-2.51%	-5.20%	-2.42%	2.36%
Canola	23.25%	13.80%	0.49%	26.48%	17.20%
Oats		5.27%			5.27%
Total	8.89%	-3.04%	-7.34%	1.61%	1.67%

Source: Calculated from Alberta Agriculture and Alberta Wheat Pool. 1989. Impact of Change to a Pay the Producer Method of Payment on Alberta's Grain and Livestock Sectors. Mimeo.

Linear programs of sample farms in each region provided no indication of change in crop rotation associated with the price level and output changes due to change in method of payment.[5] The data of Table 4.1.5 were used in present EPIC simulations to estimate the changes in cropping patterns and rates of erosion which would exist in the absence of the WGTA (see below).

4.1.4.2 Fertilizer Use

It is not likely that the decline in prices associated with demise of the WGTA would provide incentives for more intensive production (i.e., higher levels of variable inputs such as fertilizers and sprays), but some declines in the use of variable inputs cannot be totally discounted. Using standard marginal productivity estimates (Bauer 1985), and likely price effects of removal of the WGTA as of 1987, the reduced grain prices due to this simulated policy change might have led to a slight reduction in fertilizer use. The amounts by which fertilizer use would have been reduced are estimated as follows:

Wheat:
- nitrogen reduced by 0.7 kg. per hectare
- phosphorus reduced by 3.2 kg. per hectare

Barley:
- nitrogen reduced by 1.6 kg. per hectare
- phosphorus reduced by 2.1 kg. per hectare

Canola:
- nitrogen reduced by 0.7 kg. per hectare
- phosphorus reduced by 3.4 kg. per hectare

The changes in cropping patterns suggested (Table 4.1.5), however, indicate that input use has not likely been affected very significantly. Accordingly, most of the forecast changes would occur through shifts in cropping patterns, largely but not completely by changes in the amount of fallow and forage.

5 The farm-gate price changes assumed to be associated with demise of WGTA rates reflect the assumption that farmers will receive a lower price for wheat and canola which is about equal to the increase in freight charges. For barley, the price of barley is forecast to decline less in recognition of increased local use of barley in feeding, and some changes in production patterns. The estimates are based on work reported in Alberta Agriculture and Alberta Wheat Pool (1989).

4.1.4.3 Crop Rotations

One of the reactions of farmers to changes in prices may well include some change in the sequencing of crops which they raise. Farmers responding to the survey indicated current (typical 1980s) cropping rotations. Estimates are also available (Table 4.1.5) of the changes in land use patterns likely following a simulated removal of the rates embodied in the Western Grain Transportation Act. Thus, employing EPIC, three rotations were used to approximate both the current land use pattern in each region (initial land use patterns are based on Census information) and projected post-WGTA land use patterns. While a limited number of rotations is not able perfectly to simulate the actual patterns of land use, the result appears to mimic land use changes well. The rotations used, and the proportions of cultivated land on which they are employed, as well as the desired distribution of land use by region are shown in Appendix Table B.5. The post-WGTA rotations simulate a situation in which there would be increased acreage in canola and forage, decreased acreage in fallow, and modest changes in other crops.

4.1.5 Costs of Soil Erosion Due to WGTA

The effects of changing the method of payment of the WGTA, as it relates to soil conservation, appear to focus on potential changes in cropping patterns. More specifically:

- changes in cropping practices and crop rotations. In general, these changes include less fallow and more forage (which tend to be soil conserving) and added area seeded to canola (which may tend to offset those conserving forces).

- slight reductions in fertilizer use per hectare, although the amount of change in fertilizer use is reasonably sensitive to grain price levels.

The effects of these changes on soil loss over time is shown in Table 4.1.6. The results suggest that the WGTA has contributed to some losses of topsoil over time. In Southern Alberta, (Table 4.1.6) the EPIC simulation suggests the difference in topsoil depth over 50 years as a result of changing the WGTA would be a possible saving of about 7 mm. of topsoil.[6] In other regions of the province, this simulated saving would only amount to 1-2 mm. of topsoil over a 50 year period. The largest decline in erosion following change in the current method of payment of the WGTA is forecast to occur in Southern Alberta, almost exclusively because of increases in continuous cropping.

Yield changes over a 50 year period are also projected to be modest, if any (for details, see Appendix Table B.6). With constant prices, this means that aggregate gross returns per acre (and in net returns per acre) are also projected to remain relatively constant with or without the WGTA. Thus, employing this analytical framework, it does not appear possible to attach an agricultural value to the degree of erosion which is associated with the WGTA on the soils studied. Nor is it possible to attach an economic value to the degree to which erosion would be reduced by altering the payment method of the WGTA.

6 At an assumed density of 1 tonne per cubic metre, each 10 mm. of soil loss over a 50 year cycle of the EPIC simulation translates into an annual loss of 0.8 tonnes per acre (about 0.9 short tons per acre). Typical soil densities are in the range of 1 tonne to 1.15 tonnes per cubic metre.

Table 4.1.6

Simulated (50 Year Erosion Estimates and Yield Trends, Selected Alberta Regions, With and Without Effects of the Western Grain Transportation Act

Region	50 Year Erosion (mm) With WGTA	Without WGTA	Difference Due to WGTA	Significant Yield Trend
Southern Alberta	30.3	23.3	7.0	No
Central Alberta (Black Soil)	20.4	18.4	2.0	No
Central Alberta (Gray Soil)	26.1	25.6	0.5	No
Peace River (Gray Soil)	31.3	30.1	1.2	No

Source: Study estimates of cropping patterns and grain prices, and EPIC estimates of erosion and yields. For details, see Appendix B.

4.1.6 WGTA Summary

Prior and present research suggests that the major farm management response to changing the method of payment of the WGTA (or of paying the Crow Benefit in a neutral form) would be changes in the crop mix (i.e. less summerfallow and more forage and canola) and, by implication, in crop rotations. Slight reductions in fertilizer use per acre might also arise.

The implication of this for soil conservation were quantified using the EPIC simulator and generally suggested the following:

- a saving of up to 7 mm. of topsoil over a 50 year period.
- very little change in crop yields (1990 technology)
- very little (if any) change in aggregate gross returns

These seemingly modest per acre impacts, however, translate into total regional and provincial impacts which appear significant. Total soil losses due to the WGTA over a 50-year period (in million of tonnes) are estimated to be as follows:

	Million Tonnes
South	317
Central Black	74
Central Gray	6
Peace River	21
Province	418

an estimated 14 percent of all on-going wind and water erosion. This assessment would make the WGTA one of the most soil erosive programs considered in this study.

4.2 Canadian Wheat Board Quota Policy

4.2.1 The Canadian Wheat Board and Quota Policy

The Canadian Wheat Board Act has been in existence since 1935, although the powers of the Canadian Wheat Board (CWB) have changed significantly over that time. The CWB currently serves as the sole purchaser of wheat, barley and, until recently, oats for export and milling purposes. The federal government establishes initial prices for the grains over which the CWB has authority, initial prices which are guaranteed by the federal government for a crop year at a time.

In order to ration available assembly system space, the CWB has the power to use grain delivery quotas. Initially, the use of quotas in the Canadian export trade may have been viewed as a means of trying to influence international product prices. In recent decades, however, the use of delivery quotas has been seen in the role of aiding the orderly assembly of grain, and equitably sharing the burden of export or transportation system constraints. The quotas also allocate delivery opportunities during the year, since the absence of a storage premium encourages delivery as early as possible in the crop year.

4.2.2 Evolution of Quota Policy

Delivery quotas have also been utilized as a means of restricting output. The potential use of quotas for cutting back on grain production was exercised in the 1941/42 crop year. With some adjustments farmers were restricted to a quota delivery base of only 65% of their 1940 wheat area. Farmers could choose to grow more wheat than this, but they would have no assurance of compensation for the added storage cost until the next open quotas were announced. This was an attempt to adjust to smaller anticipated wheat sales due to the loss of the European market. The federal government also made wheat area reduction payments on land transferred from wheat into summerfallow, coarse grains, or perennial forage crops. While it was anticipated that the maximum quota for wheat would restrict deliveries, market conditions changed and quotas were opened in December of 1941.

While the quota acreage for wheat was set at 65% of the 1940 wheat area for the remainder of the war years, with barley and oats using actual seeded acreage as a base, maximum quotas were used sparingly, generally only to prevent congestion during harvest. Most quotas were opened by the end of the crop year. The end of the war saw wheat markets in Europe open up again, removing the need for quotas as a production control. Quotas were then used mostly to prevent seasonal congestion.

While permit books were still issued in case a future need arose, the demand for grain was so strong after the war that maximum delivery quotas for wheat were terminated in 1947. The authorized base for wheat acreage reverted to the seeded area basis used for other grains.

The strong market demand continued until 1952 when grain supplies began to mount again. As quotas began once more to restrict market access, a number of administrative changes were made. Prior to this farmers could only deliver a particular grain up to the limit specified by the existing quota and the number of acres they had stated as being seeded to that grain. A new policy introduced in 1953 allowed producers to specify an area for delivery purposes against which they could deliver any grain of their choice. This was intended to introduce some flexibility into the system. The quota system then begun to affect producer's seeding choices. If they had abundant supplies of a particular grain, the system required them to declare a certain area as seeded to this grain in order to obtain delivery privileges.

The specific area included the area sown to all grains plus summerfallow. In times of surplus, it became standard practise to include summerfallow acreage so as not to discourage farmers from reducing their seeded acreage in order to cut back on grain production. Against the base aggregate of crop areas, a general quota in bushels per acre could be delivered of any of the specified grains (including rye as well as wheat, oats, and barley). Clearly such a system still favored wheat as wheat weighed more and was worth more per bushel than other grains. With additional annual quota increments being cumulative, the general quota was simply raised until open quotas existed for all grains.

Malting barley was an exception to the rule. After the barley was selected and a premium paid by the purchaser, the farmer could deliver a full carlot. The barley was exempted from quota delivery limits. This practise became known as an "over-quota privilege".

Special delivery quotas were also extended to producers of oats and rye who had over 50% of their "specified" area sown to one of these crops. To provide greater equity in monetary returns on their initial delivery, a "unit quota" system was introduced in 1954. A unit consisted of three bushels of wheat, five bushels of barley or rye, or eight bushels of oats. The initial quota was set at 100 units from which farmers could choose any combination of the four grains not exceeding the maximum unit quota. This system tended to discriminate against wheat according to the prevailing price levels at that time. The unit quota applied to the initial delivery only, following which general quotas were announced against which any of the quota grains could be delivered. This system was continued until 1969. Durum wheat and forage crops were also included in the quota and quota acreage, while flaxseed and rapeseed were assigned separate quotas based on seeded acreage.

The unit and general quota system was not practical from the perspective of the CWB when it wished to draw forth a certain type of grain to meet sales contracts. This led the CWB to introduce "supplementary" quotas when it needed a specific type of grain. In 1965 an "advance" quota was also introduced to move a large volume of high moisture grain to avoid spoilage. Special delivery privileges were later extended to grain threatened by local flooding. "Over quota" privileges were also extended to selected oats (for milling) in addition to selected barley for malting.

When advance payments were introduced after 1957 for farm stored grain, the Board also gained greater flexibility in establishing quotas to meet market needs, since farmers' demand for cash was not as immediate.

4.2.3 Quota Review and Changes After 1970

A major quota review was carried out in 1970. In defining quota objectives, this review set a new course for quota policy. Among its major conclusions was that the primary objective of quota policy is to call forth at the right time the kinds, qualities and quantities of grain required by the market.

Since the unit quota was not conducive to this objective, the review recommended the unit quota be abolished, as well as the specified acreage quota, over-quota delivery privileges, and cumulative quotas. It recommended that there be separate quotas for each grain, but that delivery opportunities not be restricted to actual seeded acreage so as not to hold production in a certain grain when demand had fallen off. It was not viewed as important that quotas should be opened or maximized by year end if this tended to congest the handling system. It was also recommended that cumulative quotas be done away with in favor of terminating quotas to call forth the right type of grain at the right time of year, rather than allowing farmers to deliver when they wanted, which might be after a sales opportunity had elapsed.

The committee's recommendations were only partly introduced in 1970 due to the grain inventory reduction program (LIFT) which was enacted at that time. The LIFT program used a formula basing delivery privileges mostly on summerfallow area and the area sown to miscellaneous crops or perennial forages. The LIFT program, although short-lived, was an attempt to deal with the oversupply of grain accumulated in the late 1960's.

Major changes in quota policy were introduced in 1971/72. The assigned acreage base replaced the seeded and specified areas used previously. The assigned acreage base included the area sown to wheat and other quota grains, miscellaneous crops, summerfallow, and perennial forage (not exceeding 1/3 the land devoted to other uses including summerfallow). Instead of over quota privileges, specialty crops had to assign some of their acreage base. Most important, non-cumulative quotas were introduced for wheat, oats, and barley. Quotas were also allowed to be established on a grade basis to meet specific market sales. Cumulative quotas were also established for non-board grains such as rye, flaxseed, and rapeseed as both the Wheat Board and the non-board market competed for space in the same handling and storage system.

The establishment of quotas for off-board and non-board grains led to the next quota review in 1978/79 (rapeseed, flaxseed, rye, and now oats are non-board grains; barley or wheat sold to the domestic feed market are off-board grains). Changes were also made in over-delivery privileges for seed grain to increase the ability of farmers to reassign quota areas. In 1980/81 and 1983/84 regulations were changed on the reassignment of quota acres for selected grains. In 1986/87 a decision was made to restrict the acreage assignment for non-board crops to the acreage seeded to these crops, but this policy was later reversed.

During the 1980s, bonus acres and contracting acres were introduced. In the late 1970s, high levels of grain exports encouraged farmers to maximize production as they reached for export targets of 30 million tonnes of grain by 1985 and 35 million tonnes by 1990. Summerfallow was recognized as a drawback. It might restrict production in some cases, and was believed to contribute to soil degradation. The bonus acres introduced to the quota system in 1982/83 provided some disincentive for the practise of summerfallow. Seeded acres of the six major grains were totalled and divided by three. From this was deducted the total of summerfallow acres and miscellaneous crops. Those farmers who had very little acreage in summerfallow and miscellaneous crops would receive a bonus quota acreage. Bonus acres were intended to benefit those producers with more intensive production, producers believed to typically lose delivery privileges in the early part of the crop year to producers with a large summerfallow acreage.

Contracting was also introduced in the 1980s, mostly to draw barley supplies to meet export obligations. Contracting required the assignment of quota acres. For both barley and oats contracts in 1987/88, producers were required to assign 1 quota acre for every 2 tonnes contracted.

4.2.4 Quota Policy Review

In July/August of 1987 the CWB announced that it would be undertaking a full review of the quota system, inviting comments and briefs from producers and the grain industry. In noting the terms of reference the Board distinguished between years in which it may or may not be possible to sell all of a farmer's grain. In those years where it was possible to sell all grain delivered, the quota system's main purpose is to draw grain as required. In years where marketing all grain is not possible, a further objective is to allocate delivery opportunities among farmers.

In its submission to the Quota Review Committee, the Prairie Farm Rehabilitation Administration (PFRA) noted that the exclusion of uncultivated acreage from the current quota base had encouraged some farmers to break new land in order to expand their quota base. Exclusion of forage crops and miscellaneous crops from the bonus acre calculation was cited as having implications for soil conservation. The PFRA submission noted that the current quota policy extends the greatest delivery privileges to farmers who plant half their land (say to wheat) and fallow the other half.

The report of the Quota Review Committee suggested a system of quotas based on the willingness of farmers to contract delivery of grain on hand.[7] Discussion of the report and its recommendations has led to continued indecision concerning adoption of the suggested approach. At the time of writing, the modified acreage approach begun during the 1970s is still in existence.

4.2.5 Survey Responses

Table 4.2.1 indicates that about one-quarter of farm survey respondents have been influenced in some way by quota policy. Consistently, and in all regions of the province, farmers reported (Table 4.2.2) that they cultivated more land as a result of the quota system than would otherwise occur. They also reported more forage area, and more livestock production, than would have occurred in the absence of the quota. More surprisingly, many reported the quota policy had induced them to increase the application of inputs per acre. Tillage operations on the other hand, appear to have been relatively unaffected, with the South and Central

7 Such an approach has been suggested earlier as well. See, for example, Anderson 1986, 130.

Black regions reporting a small net decrease. Concerning input use per acre, and perhaps also regarding tillage operations, however, these responses may simply reflect trends underway which are relatively independent of the quota system.

Table 4.2.1

Proportion of Farmers Whose Management Decisions Were Affected by CWB Quota Policy

	Number of Responses (% of Those Responding)				
	South	Central Black	Central Grey	Peace River	All Regions[a]
Affected management	76 (24.1)	80 (24.1)	17 (16.0)	38 (30.4)	214 (24.3)
No effect on management	239 (75.9)	249 (75.7)	89 (82.4)	87 (69.6)	668 (75.7)
No response	1	5	2	1	9
Total responses	316	334	108	126	891

[a] Including responses without location coding.
Source: Questionnaire responses.

Farmers who responded to the questionnaire did not in general perceive quota policy as leading to serious soil degradation problems in their communities (Table 4.2.3). Two-thirds to three-quarters of all farmers believed that the quota system had no effect on land quality in their areas. While about 30 percent of respondents did cite an effect on soil quality, the numbers who cited it as a factor leading to improvements in soil quality (14 percent) was almost equal to the proportion who believed quotas negatively effect soil quality (16 percent).

By a slight margin, farmers perceived that quota policy has been harmful to soil quality in the communities in which they live. However, its effects on their own farms may be positive, with increased cultivated acreage balanced by more forages, more livestock, and, apparently, less fallow. These differences may reflect modifications to the quota system over time, including innovations such as "bonus acres" and barley contracts. They may also reflect on-going adjustments to the existence of a large livestock sector in Alberta.

Table 4.2.2
Effect of the CWB Quota Policy on Farmers' Own Operations in the 1980's

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	249	29 (43.3)	31 (46.3)	7 (10.4)
Summerfallow acreage	253	2 (3.2)	28 (44.4)	33 (52.4)
Forage acreage	258	16 (27.6)	35 (60.3)	7 (12.1)
Inputs per acre	254	29 (46.8)	24 (38.7)	9 (14.5)
Tillage operations	255	8 (13.1)	39 (63.9)	14 (23.0)
Livestock production	255	13 (21.3)	39 (63.9)	9 (14.8)

Region - Central Black	Number of Responses (% of Those Responding)			
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	266	25 (36.8)	39 (57.4)	4 (5.9)
Summerfallow acreage	268	3 (4.5)	34 (51.5)	29 (43.9)
Forage acreage	271	29 (46.0)	23 (36.5)	11 (17.5)
Inputs per acre	267	30 (44.8)	25 (37.3)	12 (17.9)
Tillage operations	270	10 (15.6)	41 (64.1)	13 (20.3)
Livestock production	268	30 (45.5)	31 (47.0)	5 (7.6)

Region - Central Gray	Number of Responses (% of Those Responding)			
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	92	5 (31.3)	9 (56.3)	2 (12.5)
Summerfallow acreage	93	2 (13.3)	6 (40.0)	7 (46.7)
Forage acreage	93	7 (46.7)	6 (40.0)	2 (13.3)
Inputs per acre	92	4 (25.0)	7 (43.8)	5 (31.3)
Tillage operations	93	1 (6.7)	10 (66.7)	4 (26.7)
Livestock production	92	10 (62.5)	4 (25.0)	2 (12.5)

Region - Peace River	Number of Responses (% of Those Responding)			
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	92	18 (52.9)	14 (41.2)	2 (5.9)
Summerfallow acreage	94	5 (15.6)	9 (28.1)	18 (56.3)
Forage acreage	91	16 (45.7)	12 (34.3)	7 (20.0)
Inputs per acre	92	13 (38.2)	18 (52.9)	3 (8.8)
Tillage operations	92	9 (26.5)	24 (70.6)	1 (2.9)
Livestock production	98	6 (21.4)	19 (67.9)	3 (10.7)

Province Summary	Number of Responses (% of Those Responding)			
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	699	77 (41.6)	93 (50.3)	15 (8.1)
Summerfallow acreage	708	12 (6.8)	77 (43.8)	87 (49.4)
Forage acreage	713	68 (39.8)	76 (44.4)	27 (15.8)
Inputs per acre	705	76 (42.5)	74 (41.3)	29 (16.2)
Tillage operations	710	28 (16.1)	114 (65.5)	32 (18.4)
Livestock production	713	59 (34.5)	93 (54.4)	19 (11.1)

Source: Questionnaire responses.

Table 4.2.3

Farmers' Estimates of Effects of the CWB Quota Policy on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Grey	Peace River	All Regions[b]
Strongly Negative					
- 3	6 (2.0)	13 (4.0)	3 (3.0)	2 (1.7)	24 (2.8)
- 2	20 (6.6)	14 (4.3)	6 (6.0)	10 (8.4)	50 (5.9)
- 1	18 (6.0)	23 (7.1)	5 (5.0)	13 (10.9)	61 (7.2)
No Effect	209 (69.2)	230 (68.9)	74 (74.0)	81 (68.1)	599 (70.3)
+ 1	38 (12.6)	27 (8.3)	9 (9.0)	8 (6.7)	82 (9.6)
+ 2	7 (2.3)	11 (3.4)	2 (2.0)	4 (3.4)	24 (2.8)
+ 3	4 (1.3)	6 (1.9)	1 (1.0)	1 (.8)	12 (1.4)
Strongly Positive					
No Response	14	10	8	7	39
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.2.6 Quota Policy and Cropping Patterns

Available quantitative evidence of the effect of the quota on farmer patterns of cropping behavior suggests the effect has been variable from year to year.[8] This suggests that the quota effect has been important only when grain deliveries are, or are expected to be, limiting. As a result, an estimate of cropping behavior associated with the system of Canadian Wheat Board quotas is likely to predict the effects of quota change in any one year with a high standard error. Estimates developed for the period 1976/77 to 1985/86 suggest the average annual effect of CWB quotas in Alberta during this period was as follows: -700,000 acres (283,000 hectares) of wheat and +551,400 acres (223,000 hectares) of barley (Lerohl 1987, 129-32).

Canola area changes are more difficult to predict. The gradual introduction of canola may have been speeded by the existence of quotas, but separating the trend of production from the changes due only to quota restrictions appears difficult. The response of farmers to the survey questionnaire results (e.g., Table 4.2.2) suggests that livestock related production (forages but also barley) may have been the major response to quota related concerns. The above data suggest that most (79 percent) of the acreage diverted from wheat has been planted to barley and thus, based on farmer questionnaire responses, it is assumed that the remainder of diverted acreage is planted to forage crops.

8 Estimates based a several sources are developed and discussed in Lerohl 1987, 29-32.

Simulations were conducted utilizing EPIC, assuming the projected changes in crop acreages (as above) were distributed among regions according to the total cultivated acreage in each of the four study regions (1986 Census). The rotations selected (Appendix B, Table B.7) are based on these projected land use changes and the selection of three rotations which seem best to mimic the land use patterns estimated. The results are shown in following Table 4.2.4. The results show slight effects of the change in land use associated with quotas. The result, which differs from the inferences of several qualitative studies of the issue (e.g., PFRA 1987), is due to differing estimates of the land use effects of quotas. Survey and model evidence employed in this study suggest little or no impact of the quota system on fallow acres. Much of the adverse effect of the quota system on land quality derives from an assumption that farmers increase fallow acreage in order to enhance delivery opportunity. Our survey of Alberta farmers did not support this view, and the acreages removed from wheat in this analysis are believed to be used largely for barley and forages. Nevertheless, under the more arid conditions of parts of Saskatchewan, the PFRA 1987 estimates of farmer reactions may be more appropriate than the estimates used in this study.

Table 4.2.4

Simulated (50-Year) Erosion Estimates and Yield Trends, Selected Alberta Regions, With and Without Effects of Canadian Wheat Board Quotas

	50 Year Erosion (mm)			
Region	With CWB	Without CWB	Difference Due to CWB	Significant Yield Trend
Southern Alberta	30.3	30.1	0.2	No
Central Alberta (Black Soil)	20.4	20.2	0.2	No
Central Alberta (Gray Soil)	26.1	27.0	-0.9	No
Peace River (Gray Soil)	31.3	28.7	2.6	No

Source: Study estimates of cropping patterns and grain prices, and EPIC estimates of yields and erosion.

4.2.7 Costs of Soil Erosion Due to CWB Quotas

Table 4.2.4 suggests that the amount of soil erosion which might be attributable to CWB quotas (if the barley for wheat substitution has been the main consequence) is negligible or, at worst, very slight. This impact, if any, would be most pronounced in the Peace River region.

Province-wide, therefore, no significant trend in gross returns per acre (or in net returns) was discernible with or without CWB quotas. The inference is that the production surface did not change significantly over this period, and that the degree of erosion shown to exist did not display significant output effects over as short a horizon as 50 years. Accordingly, the slight changes indicated for regions of Alberta outside the south (Table 4.2.4) also appear to have had no significant effect on soil productivity.

4.2.8 Canadian Wheat Board Quota-Summary

The estimates made indicate shifts in rotations which augment feedgrain and forage production. Predictably, this, the simulated impact of CWB quotas on soil erosion is minor. This impact (most of which is in the Peace River region) may amount to about 1 percent of total on-going erosion in the province.

The major basis for this conclusion arises because this analysis assesses the changes in fallow acres due to CWB quotas as minor. To the extent the analysis underestimates the fallow increasing effect of quotas (for example in parts of Southern Alberta) it may understate somewhat the erosive effect of CWB quotas. It may also understate the erosion effect if there has been a long term addition to the land base because of quotas, particularly on more erosive lands. These effects, however, are likely among the earliest, and most subtle, effects of such quotas.

4.3 The Western Grain Stabilization Plan

4.3.1 Background

The Western Grain Stabilization Act (WGSA) was enacted in 1976. Its goal is to stabilize incomes from the sale of Western grains, and was enacted partly in response to variable grain prices of the early 1970s. Initially, the program applied only to the six major grains: wheat, oats, barley, rye, flaxseed, and rapeseed. In 1977 the program was extended to include mustard seed and sales of pedigreed seed. A recent change, introduced in 1987/88, extends coverage to special crops including triticale, mixed grain, sunflower seed, safflower seed, buckwheat, peas, lentils, fababeans, and canary seed. The new provision also allows farmers to apply for coverage for any prescribed seed for which a grade of Canada Western has been established under the Canada Grain Act. Other grains and grains grown outside of Western Canada are eligible for public support under provisions of the Agricultural Stabilization Act which, unlike the WGSA, does not require direct contributions by farmers.

The WGSA applies only to grain sold commercially in the designated area of Western Canada. Grain companies, dealers, and processors licensed by the Canadian Grain Commission must report all purchases of the eligible grains and remit levy amounts deducted for participating producers. Unless a farmer opts out he is automatically in the program. Farmers who choose to be part of the program contribute a percentage of eligible sales, with the federal government contributing an amount equal to the farmer contribution plus 2 percentage points of sales. A large group of commercial buyers such as feed mills, seed plants, and feed lots are not licensed by the Canadian Grain Commission, but have agreed under contract with the Western Grain Stabilization Administration to report all purchases of eligible grains and levy deductions. This second group are known as designated buyers. All grain companies, dealers, and designated buyers are compensated annually for their services. In 1987/88 the minimum purchase requirement for a designated buyer was lowered to 200 tonnes from 1000 tonnes per year to expand this designation.

Farmers can also make voluntary levy contributions for commercial sales to buyers who are not licensed with the Grain Commission or designated by the WGSA, for crop insurance settlements, and for farm-to-farm sales of pedigreed seed. Beginning in 1988/89 all designated purchasers were required to deduct the stabilization levy for participating producers, while prior to this these contributions were voluntary.

Participation in the program has always been voluntary, but generous contributions by the federal government have encouraged a participation rate of over 80% in recent years. All producers who held Canadian Wheat Board delivery permits in 1975/76 were enrolled in the program when it was introduced in April of 1976. Those not wishing to participate had a three year period in which to withdraw by forwarding a signed request to the program administration. By December 31, 1976, 77% of eligible producers were participants in the program. Those withdrawing from the program and wishing to re-enter were allowed to do so by December 31, 1976 without penalty or loss of rights. All new Canadian Wheat Board permit holders were initially enrolled in the program and also allowed three years to opt out if they so chose. By the end of the third year following the introduction of the program (i.e. December 31, 1978), about 74% of the eligible permit holders remained registered in the program.

Participation in the program initially stabilized around 77% (see Table 4.3.1). While new farmers tended to remain in the program it also appears that the increase in participation rates largely came about due to declines in the number of grain permit holders. By 1986/87 the percentage of farmers in the program had risen to 82.5%. With large payouts to eligible farmers in 1984 to 1987, many farmers who had previously opted out rejoined the program, bringing the participation rate to near 90% in 1987/88.

Initially farmers opting out of the program had one opportunity to re-enter the program which they could do at any future time. For a three year period after re-entering the program they would only be eligible to receive 90% of any stabilization payment due to full participants. After 1983/84 the conditions of re-entry and withdrawal were changed somewhat as producers who had previously opted to stay in the program could opt out once every ten years. However, less than 200 producers exercised this withdrawal option in 1986, while over 3,300 producers exercised a similar option to rejoin (also allowed once every ten years) after previously withdrawing.

Table 4.3.1. Participation in Western Grain Stabilization Program

Year Crop Year	Program Participants	Producers	Participation Rate
1976	131,434	171,124	76.8%
1977	126,526	168,259	75.2%
1978	124,105	167,461	74.1%
1979	125,485	167,010	75.1%
1980	123,404	162,234	76.0%
1981	125,180	163,276	76.7%
1982	123,142	159,415	77.2%
1982/83	119,141	153,820	77.4%
1983/84	116,062	149,725	77.5%
1984/85	115,914	148,174	78.2%
1985/86	114,314	144,180	79.3%
1986/87	112,940	136,839	82.5%
1987/88	122,716	136,559	89.9%

Source: Western Grain Stabilization Administration. Various Years. Annual Reports. Ottawa: Agriculture Canada.

Because of major program changes in 1987/88 farmers were given another opportunity to withdraw by August 1, 1987. Recent program participants who had been in the program for less than three years had to decide before September 29, 1988 if they wished to withdraw. Following this, new participants would have to decide by the end of the first crop year if they wished to withdraw, thus eliminating the three year opt out provision.

The original program in 1976 called for producers to pay a 2 percent levy on a maximum of $25,000 of grain sale proceeds. On January 1, 1979 this maximum was raised to $45,000, and in 1983 and 1983/84 was raised once more to the present level of $60,000.

Initially, the government made a contribution to WGSA which was twice that of the grain producer as well as paying administration costs. The initial federal contribution was 4 percent compared to the farmer 2 percent premium. A fee was paid to grain purchasers who collected the producer premiums at the rate of one half of one percent of the total producer levy deducted per year.

As the Western Grain Stabilization Fund began to build up in the early 1980's (following the payout in 1978 and 1979) some of the rules were changed regarding contributions to the fund and the payout formula. After January 1, 1984, the producer levy was reduced to 1.5 percent of sales and the federal levy was therefore reduced to 3.5 percent. In 1985/86 the levy was again lowered to only 1 percent of grain sale proceeds for producers. This arose from a provision of the act allowing such a reduction in levies when the interest earned on the existing fund reached a certain level. Again the government matched this contribution plus an additional contribution of 2 percent for a total of 3 percent. This applied for the 1986/87 crop year as well.

The change in levies was short-lived, however. Large payouts in 1985/86 and 1986/87 (with another expected for 1987/88) lead to an increase in rates. Producer levies were raised to 4 percent which was to apply for all years in which the account was in deficit, dropping to a 3 percent levy when the account had a credit, and a 2 percent levy when the account balance exceeded 50 percent of average annual grain sale proceeds for the previous five year period. Government contributions again equaled producer contributions plus an additional 2 percent, thus making a contribution of 6 percent in 1987/88. The government had also written down 750 million dollars of the debt incurred by the fund in 1986/87.

4.3.2 Program Payouts and Payout Formula

Table 4.3.2 lists the contributions and payouts from the Western Grain Stabilization Fund from 1976 to 1987/88. The original program prescribed a payout when the net cash flow for grain producers in the designated area fell below the average of the previous five years.

Table 4.3.2.

Western Grain Stabilization Fund, Cumulative Stabilization Account January 1, 1976, to July 31, 1988 ($ millions)

Year	Producer Levy	Government Levy	Interest	Payouts	Year-end Balance
1976	24.3	48.6	1.3		74.2
1977	28.0	56.0	7.1		165.3
1978	28.4	56.8	11.7	115	147.2
1979	43.4	86.8	9.2	253	33.6
1980	48.3	96.6	9.4		187.9
1981	56.4	112.8	44.5		401.6
1982	55.5	111.0	59.9		628.0
1983	65.3	130.6	60.5		884.4
1984(Jan.-July)	26.8	62.5	52.5	223	803.2
1984-85	45.5	106.2	75.9	522	508.8
1985-86	29.9	89.7	35.4	859	(195.2)
1986-87	27.4	82.2	(18.5)	1,396	(1,500.1)
1987-88	118.4	177.6	(139.0)	693	(1,286.1)
TOTAL	597.6	1,217.5	209.9	4,061	

Source: Western Grain Stabilization Administration. 1987/88. Annual Report. Ottawa: Agriculture Canada. Exhibit J.

The payout procedure is illustrated in Table 4.3.3 for 1976 and 1977. Receipts include cash receipts for the crops covered under the program plus crop insurance payments in the Canadian Wheat Board designated area. Gross grain expenses do not include interest on outstanding debt. A marketing/production ratio is calculated to reflect the discrepancy between expenses determined for all grain produced, while cash receipts are only for grain sold.

The second payout method was introduced in 1983/84, following representations that the fund did not trigger a payout as grain prices fell. A second trigger criterion was introduced based on the cash flow per tonne of grain sold. This calculation is illustrated in Table 4.3.5, while Table 4.3.4 gives the net cash flow, 5-year moving average of net cash flow and potential payout for 1976 to 1983 and 1983/84 to 1987/88, as well as the actual payout calculations by both procedures for the latter period. The actual payout was the higher of the two which has tended to be the per tonne cash flow calculation in most years since it was introduced.

Table 4.3.3.
Sample Cash Flow Calculations, Western Grain Stabilization Act

	1976		1977	
	$(000's)	Ratios	$(000's)	Ratios
(1) Gross grain receipts	2,943		2,870	
(2) Gross grain expenses	1,347		1,454	
(3) Marketing/production ratio		0.7100		0.7403
(4) Net grain expenses (4)=(2)x(3)	958		1,076	
(5) Net grain proceeds (5)=(1)-(4)	1,985		1,794	
(6) Eligibility ratio ($25,000 proceeds limit)		0.7433		0.7363
(7) Eligibility ratio (actual producers)		0.9228		0.7363
(8) Net cash flow (8)=(5)x(6)x(7)	1,362		1,211	
(9) Five-year average net cash flow	1,219		1,365	
(10) Potential stabilization payment	nil		154	
(11) Participation ratio (participating producers)				0.7434
(12) Actual stabilization payment	nil		115	

1977 Stabilization Payment: Distribution by Province

Province	No. of Recipients	Total Payment (rounded $000's)	Average per Recipient ($)
Manitoba	24,095	17,868	742
Saskatchewan	62,695	69,092	1,102
Alberta	39,933	27,275	683
B.C.	1,513	722	477
Total	128,236	114,957	896

Source: Western Grain Stabilization Administration. 1978. Annual Report. Ottawa: Agriculture Canada, 6.

The key figure introduced in the per tonne cash flow calculation is the gross tonnes marketed. A moving average net cash flow per tonne is calculated. When the net cash flow per tonne falls below the five year average a payout is triggered. From the calculations for 1982/83 it can be noted that a payout would have been triggered by the new per tonne method of calculation in that crop year, but not by the previous aggregate cash flow calculation. No payout was made for 1982/83 because the new laws were not in force at that time and the formula was not retroactive. The new approach requires only one of the formulas to trigger a payout and when both are triggered the higher payout is made. The 1984/85 crop year is the only example in which the original method of calculation yielded a higher payout, leading in that year to a payout of $522 million rather than the $283 million indicated by the per tonne cash flow calculation. In all other years to date, the per tonne method has triggered a higher payout than the aggregate cash flow procedure.

Table 4.3.4
WGSA Net Cash Flow and Potential/Actual Payout Calculations, 1976-1987/88
($000)

Crop Year or Calendar Year	Net Cash Flow (NCF)	Previous 5 Year Average of NCF	Potential Stabilization Payment
1976	1362	1219	
1977	1211	1365	154
1978	1097	1439	342
1979	1868	1773	
1980	2122	1682	
1981	2428	1691	
1982	2375	1994	
1983	2376	2165	
1983/84	2225	2391	166
1984/85	1840	2512	672
1985/86	1481	2435	954
1986/87	934	2110	1176
1987/88	897	1817	920

		Actual Payout	
	Potential Payout	Original[a]	Per Tonne Cash Flow
1983/84	166	128	223
1984/85	672	522	283
1985/86	954	750	859
1986/87	1176	947	1398
1987/88	920	783	958

[a] The actual payout under the original method adjusted the potential payout by the number of participating producers.

Note: After 1983/84, the actual payout is the higher of the two methods of payout calculation.

Source: Western Grain Stabilization Administration. Various Years. Annual Reports. Ottawa: Agriculture Canada. For a discussion of the method of calculating payments, see Spriggs (1985).

4.3.3 Survey Responses

Overall, 85 percent of respondents indicated participation in the WGSA. (Table 4.3.5) only a small minority (17 percent) indicated that management decisions had been influenced by participation in the WGSA. The major change in farm operation reported by respondents (Table 4.3.6) was apparently associated with input use. In the South, Central Black and Peace River regions, farmers reported that input use per acre was influenced more than any other aspect of management decisions. In the Central Gray region, the responses suggested that more livestock production and more forage production were also outcomes of the

WGSA, moreover, and that the WGSA had led to increased cultivated acreage. The number of responses in total was not large in this region, however, suggesting that few respondents placed much emphasis on the WGSA provisions in making their management decisions.

Table 4.3.5

Proportion of Farmers Whose Management Decisions were Affected by Western Grain Stabilization Program

	Number of Responses (% of Responses to Respective Question)				
	South	Central Black	Central Gray	Peace River	All Regions[a]
Participated in WGSA	275 (87.0)	277 (82.9)	89 (82.4)	112 (88.9)	759 (85.2)
Affected management	43 (15.5)	44 (15.4)	22 (23.2)	25 (22.5)	134 (17.3)
No effect on management	235 (84.5)	241 (84.8)	73 (76.8)	86 (77.5)	642 (82.7)
No response	38	49	13	15	115
Total responses	316	334	108	126	891

[a] Including responses without location coding.
Source: Questionnaire responses.

Table 4.3.6
Effect of the WGSA on Farmers' Own Operations in the 1980's

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	269	11 (23.4)	35 (74.5)	1 (2.1)
Summerfallow acreage	268	1 (2.1)	28 (58.3)	19 (39.6)
Forage acreage	271	7 (15.6)	33 (73.3)	5 (11.1)
Inputs per acre	266	24 (48.0)	22 (44.0)	4 (8.0)
Tillage operations	268	8 (16.7)	30 (62.5)	10 (20.8)
Livestock production	269	13 (27.7)	29 (61.7)	5 (10.8)

Region - Central Black	Number of Responses (% of Those Responding)			
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	292	16 (38.1)	23 (54.8)	3 (7.1)
Summerfallow acreage	292	6 (14.3)	19 (45.2)	17 (40.5)
Forage acreage	293	13 (31.7)	19 (46.3)	9 (22.0)
Inputs per acre	291	24 (55.8)	12 (27.9)	7 (16.3)
Tillage operations	292	8 (19.0)	27 (64.3)	7 (16.7)
Livestock production	293	18 (43.9)	17 (41.5)	6 (14.6)

Region - Central Gray	Number of Responses (% of Those Responding)			
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	82	11 (42.3)	11 (42.3)	4 (15.4)
Summerfallow acreage	83	1 (4.0)	15 (60.0)	9 (36.0)
Forage acreage	84	14 (58.3)	6 (25.0)	4 (16.7)
Inputs per acre	83	9 (36.0)	8 (32.0)	8 (32.0)
Tillage operations	83	4 (16.0)	16 (64.0)	5 (20.0)
Livestock production	84	12 (50.0)	10 (41.7)	2 (8.3)

Region - Peace River	Number of Responses (% of Those Responding)			
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	97	11 (37.9)	18 (62.1)	0 (0.0)
Summerfallow acreage	103	2 (8.7)	12 (52.2)	9 (39.1)
Forage acreage	101	6 (24.0)	13 (52.0)	6 (24.0)
Inputs per acre	97	17 (58.6)	11 (37.9)	1 (3.4)
Tillage operations	101	7 (28.0)	13 (52.0)	5 (20.0)
Livestock production	106	1 (5.0)	15 (75.0)	4 (20.0)

Province Summary	Number of Responses (% of Those Responding)			
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	740	49 (34.0)	87 (60.4)	8 (5.6)
Summerfallow acreage	746	10 (7.2)	74 (53.6)	54 (39.1)
Forage acreage	749	40 (29.6)	71 (52.6)	24 (17.8)
Inputs per acre	737	74 (50.3)	53 (36.1)	20 (13.6)
Tillage operations	744	27 (19.3)	86 (61.4)	27 (19.3)
Livestock production	752	44 (33.3)	71 (53.8)	17 (12.9)

Source: Questionnaire responses.

Table 4.3.7 indicates that more than three-quarters of farmers surveyed believe that existence of the WGSA has had no effect on land quality in their communities. Of those who indicated an effect, most indicated a slight effect, and farmers were almost evenly split on whether soil quality was lessened (11 percent) or enhanced (13 percent) by the existence of the WGSA.

Table 4.3.7

Farmers' Estimates of Effects of the WGSA on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
-3	8 (2.7)	8 (2.5)	1 (1.0)	2 (1.7)	19 (2.3)
-2	7 (2.4)	8 (2.5)	4 (4.0)	3 (2.5)	22 (2.6)
-1	13 (4.4)	21 (6.6)	7 (7.1)	8 (6.6)	49 (5.8)
No Effect	226 (76.6)	243 (75.9)	72 (72.7)	97 (80.2)	644 (76.5)
+1	29 (9.8)	18 (5.6)	5 (5.1)	7 (5.8)	60 (7.1)
+2	9 (3.1)	14 (4.4)	7 (7.1)	3 (2.5)	33 (3.9)
+3	3 (1.0)	8 (2.5)	3 (3.0)	1 (.8)	15 (1.8)
Strongly Positive					
No Response	21	14	9	5	49
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality.

Source: Questionnaire responses.

4.3.4 WGSA Effects

The WGSA program was intended to be resource neutral, but may have encouraged some grain farming on marginal lands. When grain prices fell sharply it may have had a tendency to keep farmers producing grain rather than switching to forages. However, when prices declined it may also have encouraged farmers to grow grains rather than fallow land, which can be viewed as assisting to maintain soil quality. Table 4.3.6 suggests the most likely effect of the program was to stimulate a slight increase in input use in each of the regions involved (more questionable in the Central Gray soil region). Evidence with respect to changes in cropping patterns is mixed at best, although the program may have slowed somewhat the change in production patterns from cereals (including wheat) to cash crops (such as canola) and perhaps forage.

The choice of the period for analysis of WGSA effects would appear especially important. Several large payouts were made in the later years of the 1980s, but payouts have not occurred in the last two (1988/89 and 1989/90) crop years. Consequently, one would expect that the main recent effect (aside from some risk-shifting) would be the slight added cost involved in membership in the Western Grain Stabilization Program. The inference drawn in assessing program effects is therefore that the program has not influenced crop selection, but has (in the late 1980s at least,) largely influenced input levels (primarily fertilizer use).

This is consistent with views expressed by Spinelli (1985) and by Gould, Spriggs and Koroluk (1988). Another analysis (Weisensel *et al* 1990), have also suggested few if any effects on output.[9] One might anticipate that it would reduce those slightly during "normal" times (i.e., times when a payout is not anticipated), and increase fertilizer use somewhat when a payout is expected within the next 3 years. The effect which is simulated is only that of a modest (arbitrarily selected) 10 percent decrease in fertilizer use due to demise of WGSA (i.e., a decline in fertilizer use in absence of WGSA).

The effects of the change are predictably slight. Yields change only slightly, and topsoil loss, shown in Table 4.3.8, is not significantly affected. There may have been a very slight negative impact in the Peace River region.

Table 4.3.8

Simulated (50-Year) Erosion Estimates and Yield Trends, Selected Alberta Regions, With and Without Effects of the Western Grain Stabilization Act

	50 Year Erosion (mm)			
Region	With WGSA	Without WGSA	Difference Due to WGSA	Significant Yield Trend
Southern Alberta	30.3	30.1	0.2	No
Central Alberta (Black Soil)	20.4	20.6	-0.2	No
Central Alberta (Gray Soil)	26.1	26.0	0.1	No
Peace River (Gray Soil)	31.3	30.6	0.7	No

Source: Study estimates of cropping patterns and grain prices, and EPIC estimates of erosion and yields. EPIC estimates inferred from EPIC simulations of +10% (see Appendix Table B.8).

9 In particular, see Weisensel *et al* 1990, Table 8. A variable relating to fallow acreages (ST/AC) is either absent or statistically non-significant at typical levels of significance. Inputs per acre (VA/P) is present in the equations for each of the 4 regions of the study. The variable, is, however, small and its direction inconsistent.

4.4 Farm Fuel Programs

4.4.1 Introduction

Farm fuel in the form of gasoline and diesel is an important source of energy used in Alberta agriculture. Farm fuel is required for field operations such as tillage, seeding and harvesting as well as for transportation of farm supplies and products, the processing and distribution of feed and the heating of farm buildings. Farmers are particularly dependent on gasoline and diesel in their farming operations. Recognizing the importance of gasoline and diesel as key inputs, the federal and provincial governments have introduced fuel rebates, refunds and tax exemptions to reduce the costs of these inputs to agriculture.

Although these farm fuel price/cost reduction programs are popular means of supporting agriculture, they may inhibit the adoption of improved soil conservation practices in Alberta. This section summarizes historical fuel prices and fuel use data, and examines possible impacts on soil quality.

4.4.2 Fuel Rebates, Refunds, Allowances and Tax Exemptions

Fuel purchased for use in farming operations in Alberta is "marked" by use of a dye (purple during the past decades with a change to red currently underway). The provincial government has for several decades provided a partial or full fuel tax exemption on fuel used in farming operations. In addition the provincial government introduced an Alberta Farm Fuel Distribution Allowance (AFFDA) on gasoline, diesel and heating fuel in 1974. Under this program, price rebates at time of purchase are available on marked fuel used in farming operations. In 1979, the federal government introduced an excise tax on gasoline and has refunded to farmers a portion of this excise tax. In addition, in 1984 the federal government introduced a fuel rebate on all gasoline and diesel used off-highway. These federal fuel rebates are available upon application for refund. An historical summary of the rebates on gasoline and diesel is shown in Table 4.4.1.

Table 4.4.1

Historical Farm Fuel Rebates, Allowances and Tax Exemptions (cents per litre)

	Alberta-Provincial						Federal		
	Provincial Tax Exemption			AFFDA			Excise Tax Refund on Gasoline	Fuel Tax Rebate	
	Gasoline			Gasoline					
Date	Regular	Unleaded	Diesel	Regular	Unleaded	Diesel		Gasoline	Diesel
May 1, 1974	1.5 of 2.2	n/a	1.9 of 2.6	1.1	n/a	1.1	n/a	n/a	n/a
Sept 2, 1975	1.5 of 2.2	n/a	1.9 of 2.6	1.8	n/a	1.8	n/a	n/a	n/a
Apr 1, 1978	No Tax	n/a	No Tax	2.6	n/a	2.6	n/a	n/a	n/a
June 1, 1979	No Tax	n/a	No Tax	2.6	n/a	2.6	1.5	n/a	n/a
Apr 23, 1982	No Tax	n/a	No Tax	7.0	n/a	7.0	1.5	n/a	n/a
Dec 1, 1984	No Tax	n/a	No Tax	7.0	n/a	7.0	1.5	4.8	4.8
June 1, 1985	No Tax	n/a	No Tax	7.0	n/a	7.0	1.5	3.0	3.0
July 1, 1985	No Tax	n/a	No Tax	7.0	7.0	7.0	1.5	3.0	3.0
Dec 1, 1985	No Tax	n/a	No Tax	14.0	14.0	14.0	1.5	3.0	3.0
May 1, 1986	No Tax	n/a	No Tax	14.0	14.0	14.0	1.5	5.5	5.5
Jan 1, 1987	No Tax	n/a	No Tax	14.0	14.0	14.0	1.5	6.5	6.5
Feb 19, 1987	No Tax	n/a	No Tax	14.0	14.0	14.0	1.5	7.5	7.5
June 1, 1987	5.0	5.0	5.0	9.0	9.0	9.0	1.5	7.5	7.5
Apr 1, 19887	5.0	5.0	5.0	9.0	9.0	9.0	1.5	8.5	7.5
Mar 7, 1989	5.0	5.0	5.0	9.0	9.0	14.0	1.5	8.5	7.5
Jan 1, 1990	5.0	5.0	5.0	9.0	9.0	14.0	1.5	3.5	3.5
Mar 23, 1990	7.0	7.0	7.0	7.0	7.0	12.0	1.5	3.5	3.5

Source: Unpublished data.

There are several differences between the provincial and federal fuel programs in addition to the amount of rebate. First the provincial programs provide the AFFDA rebate and the tax exemption at time of purchase to farmers who carry out farming operations and who have filed a farmer declaration. These programs are applied at point of sale at the time of invoicing. The marking of fuel is used as a means of monitoring use of fuel on which the allowances and tax exemptions have been applied. Marked fuel can be used off-highway (i.e., field and stationary operations) as well as for highway use in trucks for farm business and personal use.

The federal fuel rebate programs, on the other hand, do not apply at point of sale nor do they apply to the same definition of use. Farmers must apply for the refunds. The excise tax rebate applies to gasoline used in farming operations including off-highway and on-highway business use (personal use does not apply). The federal fuel tax rebate, however, only applies for off-highway use (field or stationary use). The federal programs are subject to change on January 1, 1991 at which time the rebate programs will be terminated, the GST will replace the federal sales tax, and an input tax credit will replace the rebate programs.

4.4.3 Farm Fuel Prices

Sample farm fuel price data for 1988, 1989 and 1990 are shown in Table 4.4.2. The price data permit examining the following three price scenarios:

1. The price that farmers paid for marked fuel at the time of purchase (the price that would most affect their purchase decisions).
2. The price that farmers would have had to pay if no fuel rebates or allowances were in effect.
3. The net price of the fuel for off-highway use if the farmer would have applied for all federal rebates.

Table 4.4.2

Net Farm Fuel Prices to Alberta Farmers at Recent Dates

	Gasoline		Diesel	
	Price	% Discount	Price	% Discount
April, 1988				
No rebates	41.60	--	38.56	--
After provincial rebates	27.60	33.6	24.56	36.3
After federal refunds (off-highway)	17.60	57.7	17.06	55.7
April, 1989				
No rebates	39.25	--	35.31	--
After provincial rebates	25.25	35.7	16.31	53.8
After federal refunds (off-highway)	15.25	61.1	8.81	75.0
January, 1990				
No rebates	44.75	--	38.37	--
After provincial rebates	30.75	31.3	19.37	49.5
After federal refunds (off-highway)	25.75	42.5	15.87	58.6

Source: Calculated from available data on rebates, refunds and estimated fuel price levels.

4.4.4 Farm Fuel Sales / Use

Marked gasoline sales declined during the period 1975-76 to 1985-86. In 1986-87 this general trend reversed and sales have increased over the past four years, returning to the sale volumes that existed in the late 1970's. This increasing trend in sales has been due to several factors (L. Huisman, personal communication):

1. Unleaded gasoline was not marked prior to July 1, 1985. On July 1, 1985 unleaded gasoline was marked and farmers were able to receive the same provincial rebates and discounts as available on regular leaded gasoline.
2. In recent years, the number of farm trucks that use unleaded gasoline has increased.
3. Possible increase in illegal use of marked gasoline.

The recent increases in farm fuel sales are opposite the general overall trend of decreasing fuel sales province wide (Alberta Treasury data). According to industry personnel (personal communications, July 1990), this decline typically averages about 2% per year.

Diesel fuel sales on Alberta farms have shown regular increases over the past 14 years, and are presently about twice those of more than a decade ago. On-highway non-farm use of diesel has increased as well; however, the increases of farm fuel use are much higher than for on-highway use of diesel.

Farm fuel sales are highest during the spring (April and May), decreasing in June and July, followed by increases again in August to October, and declining during the winter. This pattern follows the expected fuel demand for farm operations.

4.4.5 Price Versus Sales Volume Comparisons

It is difficult to establish a definite statistical relationship between price and fuel consumption. During years of high diesel prices (i.e., 1982 to 1985), diesel fuel sales volumes tended to be stable (or decrease). This followed several years of relatively large increases in sales prior to 1982. As prices decreased again in 1986 to 1989, relatively high increases in sales volumes of diesel were recorded. Peaks in sales volumes of diesel in 1987-88 and 1989-90 also coincided with the price wars of 1987 and 1989. Industry personnel argue (personal communications, July 1990) that annual demand is largely a function of prevailing technologies, particularly motor efficiencies and cultural practices.

Attempts to develop a price elasticity from these data proved futile, however, with no statistically significant relationship emerging.

4.4.6 Comparison of Farm Fuel Benefits in Canada

A comparison of farm fuel benefits in Canada is presented in summary format for mid-1989 in Table 4.4.3 (J. Chang, personal communication). Based on the information presented, the gasoline and diesel costs of the one-section farm illustrated ranges from a low of $3,290 in Alberta to a high of $7,902 in Newfoundland. Alberta is by far the lowest at $3,290 followed by Manitoba at $5,890 and Saskatchewan at $6,020. Net fuel prices for off-highway use after all discounts ranged from $0.161 / L to $0.328 / L for gasoline and $0.128 / L to $0.383 / L for diesel.

Table 4.4.3

Comparison of Farm Fuel Benefits in Canada

	B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	Nfld.
Gross Fuel Prices Before Provincial Taxes:[a]										
- Unleaded Gasoline	39.8	35.1	36.9	35.8	35.9	41.4	39.7	40.8	41.9	42.8
- Diesel Fuel	33.0	34.3	40.8	36.6	35.4	39.5	35.1	41.3	39.4	45.8
Net Fuel Prices to Farmers (Off-Road Use):[a]										
- Unleaded Gasoline	32.4	16.1	24.9	25.8	25.9	31.4	29.7	30.8	31.9	32.8
- Diesel Fuel	30.7	12.8	31.3	29.1	27.9	32.0	28.2	33.8	31.9	38.3
Total farm fuel costs of a one-section farm using 10,000 litres of gasoline and 10,000 litres of diesel fuel, of which 4,000 litres of gasoline is used for farm trucks:										
Diesel Fuel	$3,078	$1,200	$3,130	$2,910	$2,790	$3,200	$2,820	$3.380	$3,190	$3,830
Gasoline Used Off-Road	1,944	966	1,494	1,548	1,554	1,884	1,782	1,848	1,914	1,968
Gasoline Used On-Road	1,696	1,044	1,396	1,432	1,848	2,232	2,004	1,980	2,024	2,104
Total Fuel Cost	$6,718	$3,290	$6,020	$5,890	$6,192	$7,316	$6,606	$7,208	$7,128	$7,902

[a] Prices are based on Statistics Canada average retail prices for selected cities between April 1988 and July 1989.

4.4.7 Comparison of Regional Fuel Use on Grain and Oilseed Farms

An analysis of fuel use on prairie grain and oilseed farms presented by soil zone (using a 1982 Farm Energy Use Survey by Statistics Canada) was reported by Agriculture Canada (Culver 1984). Average fuel use in all soil zones was 48.0 L / cultivated ha (19.4 L / cultivated acre) ranging from 32.9 L / cultivated ha (13.3 L / cultivated acre) in the brown soil zone to 73.1 L / cultivated ha (29.7 L / cultivated acre) in the gray wooded soil zone. The averages showed an increase in fuel use from the brown soil zone, to the dark brown soil zone, to the black soil zone and to the gray wooded soil zone. Fuel use on individual farms, however, varied between low-usage groups of farms and high-usage groups of farms ranging between 14.9 L / cultivated ha to 113.1 L / cultivated ha.

This analysis also examined the size of operation of each of three fuel usage groups (low, medium and high) in each of the four soil zones. The data indicated that fuel used per cultivated hectare generally decreased as farm size increased. The analysis also determined that the proportion of summerfallow land did not have a major effect on fuel use. It was found that horsepower per cultivated hectare affected the amount of fuel used in field operations; fuel use increased as horsepower increased. These results were as expected explaining the increases in fuel use from the brown soil zone to the gray wooded soil zone (from the south to the north) in Alberta. Higher fuel use in the black and gray soil zones reflect the effects of smaller farm sizes, larger horsepower requirements per unit of land area, and the increased number of field operations.

4.4.8 The Impact of Government Fuel Rebate Programs on Farm Income and Expenses

Data on farm cash receipts and expenses, farm fuel costs, and the value of government fuel rebates are summarized in Table 4.4.4.

Fuels and lubricants (a majority of which are gasoline and diesel costs) cost Alberta farmer $157 million to $209 million annually between 1986 and 1990, comprising 5.7 to 7.3% of total operating costs on Alberta farms. The value of government fuel rebates and the tax exemptions vary from $143 million to $203 million annually. If these rebates and tax exemptions were not available to Alberta farmers, fuel and lubricant costs would have been approximately double (increased by a factor of 1.73 in 1988 to 2.29 in 1986). The impact of the government fuel programs is even more pronounced when the value of these government rebates and tax exemptions are related to the effect on realized net farm income. If the fuel rebates were not available, realized net income would have been sharply lower, declining by more than 50% in 1986 and 1990.

Table 4.4.4
Farm Fuel Costs, Farm Cash Receipts and Expenses, 1986-1990
($ '000)

	1986	1987	1988	1989	1990[a]
Cash receipts from crops	1,813,000	2,086,000	2,302,000	2,169,000	1,841,000
Cash receipts from livestock	1,947,000	1,926,000	2,139,000	2,294,000	2,214,000
Total farm cash receipts	3,760,000	4,012,000	4,441,000	4,463,000	4,055,000
Fuel and lubricants (after rebates)	157,000	198,000	197,000	180,000	209,000
(% of operating costs)	5.7	7.3	6.9	5.8	6.8
Total operating expenses	2,750,000	2,729,000	2,873,000	3,078,000	3,060,000
Total depreciation	670,000	666,000	667,000	676,000	680,000
Total operating expenses & depreciation	3,420,000	3,395,000	3,540,000	3,754,000	3,740,000
Net farm cash receipts	1,010,000	1,283,000	1,568,000	1,385,000	995,000
Income in kind	359,000	639,000	922,000	730,000	337,000
AFFDA	186,000	129,000	88,000	134,000	114,000
Federal fuel rebate	16,000	8,000	7,000	8,000	8,000
Provincial tax exemption	--	25,000	48,000	55,000	81,000
Total fuel 'rebates'	202,000	162,000	143,000	197,000	203,000
Projected *(if no fuel rebates)*					
Fuel and lubricants	359,000	360,000	340,000	377,000	412,000
(% of operating costs)	12.2	12.5	11.3	11.5	12.6
(size of increase %)	229	182	173	209	197
Total operating costs	2,952,000	2,891,000	3,016,000	3,275,000	3,263,000
Realized net income	157,000	477,000	779,000	533,000	134,000
(RNI decrease %)	56.3	25.4	15.5	27.0	60.2

Note: 1989 Data - Preliminary Estimates. 1990 Data - Forecast.

[1] Early projection.

Source: Basic data from Statistics Branch, Alberta Agriculture, and Alberta Treasury.

4.4.9 Fuel Usage for Tillage Alternatives

Three conservation tillage systems are compared to conventional tillage in Tables 4.4.5 to 4.4.6.

Table 4.4.5

On-Farm Conservation Tillage Example - Assumptions

	Conventional Tillage	Reduced Tillage	Minimum Tillage	Zero Tillage
Fall Tillage	Cultivate (and incorporate fert.)	Let stubble stand	Let stubble stand	Let stubble stand
Crop Year	2 Cultivations (primary and secondary)	2 Cultivations (incorporate fert.)	1 Cultivation (incorporate fert.)	Spray Glyphosate
	2 Harrowing	1 Harrowing	1 Harrowing	
	Seeding (d.d. press drill)	Seeding (d.d. press drill)	Seeding (d.d. press drill)	Seeding (zero till drill with banding of fert.)
	Spray Herbicide	Spray Herbicide	Spray Herbicide	Spray Herbicide
	Swath/Combine	Swath/Combine	Swath/Combine	Swath/Combine
FUEL USE:				
Fall Cultivation	3.4 L/ac			
Spring Cultivation	5.7 L/ac	5.7 L/ac	3.4 L/ac	--
Harrowing	1.5 L/ac	0.8 L/ac	0.8 L/ac	--
Spray	--	--	--	0.7 L/ac
Seeding	1.8 L/ac	1.8 L/ac	1.8 L/ac	2.2 L/ac
Spray	0.7 L/ac	0.7 L/ac	0.7 L/ac	0.7 L/ac
Swath/Combine	5.3 L/ac	5.3 L/ac	5.3 L/ac	5.3 L/ac
Total	18.4 L/ac	14.3 L/ac	12.0 L/ac	8.9 L/ac

Table 4.4.6

Comparison of Fuel Costs for Tillage Alternatives

(1,000 acres of cropland)

	Conventional	Reduced Tillage	Minimum Tillage	Zero Tillage
FUEL USED (L/ac)	18.4	14.3	12.0	8.9
FUEL PRICE (cents/litre)[a]				
Fuel Paid (net prov. rebates)	18.5	18.5	18.5	18.5
Price After Federal Rebates	11.0	11.0	11.0	11.0
Price if No Government Programs	37.5	37.5	37.5	37.5
FUEL COST ($/acre)[b]				
Price Paid (net prov. rebates)	3.40	2.65	2.22	1.65
Price After Federal Rebates	2.02	1.57	1.32	0.98
Price if No Government Programs	6.90	5.36	4.50	3.34
TOTAL FUEL COST ($)[b,c]				
Price Paid (net prov. rebates)	(4,330) 3,400	2,650	2,220	1,650
Price After Federal Rebates	(2,570) 2,020	1,570	1,320	980
Price if No Government Programs	(8,780) 6,900	5,360	4,500	3,340

[a] September, 1989 diesel price.

[b] Field operations only. Summerfallow costs not included. Only costs of crop year included.

[c] Including 4-6 cultivations of the fallow year (50% crop - 50% fallow rotation) would raise the total costs of the conventional tillage option significantly. Based on 4 fallow cultivations, conventional data including fallow are those shown in parentheses.

The on-farm conservation tillage example illustrates that significant savings in fuel costs can be achieved by conservation tillage practices (other associated costs not included). These savings become more pronounced when government fuel rebates and tax exemptions are not available. This illustrates the projected impact on an individual farm if the fuel programs were eliminated. Conservation tillage practices would create fuel cost savings and encourage other farming alternatives (e.g., chemical weed control).

4.4.10 Survey Responses

A minority of respondents (29 percent) indicated the existence of fuel rebates have influenced their operations in some way (Table 4.4.7). The major effects cited (Table 4.4.8) are added tillage operations, more inputs per acre, and additional cultivated acreage. Summerfallow does not appear to be influenced, and few respondents experience effects on forage acreage or livestock production. About 30 percent of farmers believe that fuel rebates have impacted on soil quality (Table 4.4.9). However, some respondents (17%) reported that fuel rebates had benefited soil conservation, while an almost similar number (13%) hold the opposite view.

Table 4.4.7

Proportion of Farmers Whose Management Decisions were Affected by Farm Fuel Rebates

	Number of Responses (% of Responses to Respective Question)				
	South	Central Black	Central Gray	Peace River	All Regions[a]
Affected management	73 (23.4)	92 (27.8)	44 (41.1)	45 (35.7)	254 (28.8)
No effect on management	239 (76.6)	239 (72.2)	63 (58.3)	79 (62.7)	617 (71.2)
No response	4	3	1	2	10
Total responses	316	334	108	126	891

[a] Including responses without location coding.
Source: Questionnaire responses.

Table 4.4.8
Effect of the Farm Fuel Rebates on Farmers' Own Operations in the 1980's

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	254	25 (40.3)	35 (56.5)	2 (3.2)
Summerfallow acreage	257	7 (11.9)	43 (72.9)	9 (15.3)
Forage acreage	259	14 (24.6)	39 (68.4)	4 (7.0)
Inputs per acre	255	34 (55.7)	14 (23.0)	13 (21.3)
Tillage operations	254	32 (51.6)	19 (30.6)	11 (17.7)
Livestock production	263	9 (17.0)	39 (73.6)	5 (9.4)

Region - Central Black	Number of Responses (% of Those Responding)			
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	255	30 (38.0)	39 (49.4)	10 (12.7)
Summerfallow acreage	257	19 (24.7)	35 (45.5)	23 (29.9)
Forage acreage	266	23 (33.8)	39 (57.4)	6 (8.8)
Inputs per acre	257	40 (51.9)	20 (26.0)	17 (22.1)
Tillage operations	254	40 (50.0)	22 (27.5)	18 (22.5)
Livestock production	260	23 (31.1)	43 (58.1)	8 (10.8)

Region - Central Gray	Number of Responses (% of Those Responding)			
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	67	24 (58.5)	14 (34.1)	3 (7.3)
Summerfallow acreage	70	14 (36.8)	20 (52.6)	4 (10.5)
Forage acreage	72	19 (52.8)	14 (38.9)	3 (8.3)
Inputs per acre	69	17 (43.6)	15 (38.4)	7 (17.9)
Tillage operations	68	24 (60.0)	11 (27.5)	5 (12.5)
Livestock production	70	17 (44.7)	18 (47.4)	3 (7.9)

Region - Peace River	Number of Responses (% of Those Responding)			
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	85	24 (58.5)	17 (41.5)	0 (0.0)
Summerfallow acreage	90	12 (33.3)	17 (47.2)	7 (19.4)
Forage acreage	90	8 (22.2)	18 (50.0)	10 (27.8)
Inputs per acre	88	21 (55.3)	13 (34.2)	4 (10.5)
Tillage operations	82	28 (63.6)	12 (27.3)	4 (9.1)
Livestock production	97	7 (24.1)	19 (65.5)	3 (10.3)

Province Summary	Number of Responses (% of Those Responding)			
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	661	103 (46.2)	105 (47.1)	15 (6.7)
Summerfallow acreage	674	52 (24.8)	115 (54.8)	43 (20.5)
Forage acreage	687	64 (32.5)	110 (55.8)	23 (11.7)
Inputs per acre	669	112 (52.1)	62 (28.8)	41 (19.1)
Tillage operations	658	124 (54.9)	64 (28.3)	38 (16.8)
Livestock production	690	56 (28.9)	119 (61.3)	19 (9.8)

Source: Questionnaire responses.

Table 4.4.9

Farmers' Estimates of Effects of Farm Fuel Rebates on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
- 3	8 (2.7)	8 (2.5)	3 (3.0)	2 (1.6)	18 (2.1)
- 2	11 (3.8)	12 (3.7)	2 (2.0)	4 (3.3)	30 (3.6)
- 1	24 (8.2)	33 (10.2)	11 (11.1)	10 (8.2)	78 (9.2)
No Effect	207 (70.6)	221 (68.4)	63 (63.6)	82 (67.2)	577 (68.4)
+ 1	23 (7.8)	18 (5.6)	8 (8.1)	10 (8.2)	59 (7.0)
+ 2	8 (2.7)	14 (4.3)	5 (5.1)	10 (8.2)	37 (4.4)
+ 3	15 (5.1)	17 (5.3)	7 (7.1)	4 (3.3)	45 (5.3)
Strongly Positive					
No Response	23	11	9	4	47
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.4.11 Farm Fuel Rebate Effects

Linear program analysis of sample farms from each area with a given technology indicated no change in cropping practices as a result of the increase in costs of cropping activities likely to arise from eliminating provincial and federal fuel rebates. In practice, however, fuel savings are possible from certain changes in practices associated in whole or in part with increasing farm sizes. Examples are carrying out multiple field operations in one pass, use of technology appropriate to multiple operations such as air-seeders and related technology, and shifts toward certain types of conservation tillage systems.

The types of impacts anticipated in the absence of fuel rebates would therefore, likely lead largely at least, to an acceleration of on-going structural changes in farm size and technology. It is the relative size of this stimulus that is ambiguous.

To provide some indication of what impact the absence of fuel rebates would have on soil conservation in Alberta, it was assumed that one tillage operation would be eliminated. This was considered the most likely response based on follow-up telephone interviews with 20 randomly selected survey respondents. This change was then simulated utilizing EPIC to generate the results indicated in Table 4.4.10.

These results suggest that, in every region of the province, somewhat less erosion would occur in the absence of farm fuel rebates. This change would be particularly pronounced in the Central Black and Peace River regions. The simulated saving would be as high as 6 mm. of topsoil over a 50 year period.

Table 4.4.10

Simulated (50-Year) Erosion Estimates and Yield Trends, Selected Alberta Regions, With and Without Effects of Farm Fuel Rebates

Region	50 Year Erosion (mm) With Farm Fuel Rebates	50 Year Erosion (mm) Without Farm Fuel Rebates	50 Year Erosion (mm) Difference Due to Farm Fuel Rebates	Significant Yield Trend
Southern Alberta	30.3	29.8	0.5	No
Central Alberta (Black Soil)	20.4	14.4	6.0	No
Central Alberta (Gray Soil)	26.1	24.7	1.4	No
Peace River (Gray Soil)	31.3	26.6	4.7	No

Source: Study estimates of cropping patterns and grain prices, and EPIC estimates of erosion and yields.

The significance of this simulated reduction in soil erosion (without farm fuel rebates) can be better understood in terms of the potential total soil saved (in millions of tonnes) over the simulated period:

	Million Tonnes
South	23
Central Black	225
Central Gray	17
Peace River	81
Province	346

This represents an estimated 12 percent of all on-going wind and water erosion in the province. This assessment suggests farm fuel rebates contribute about as much to soil degradation in the province as the WGTA, making these two programs the largest contributors to soil erosion of the programs considered here.

At the same time, yields are not projected to decline and no indication of a trend in yield changes was found. Thus, the study found no measurable on-site agricultural costs due to yield reductions over the 50-year period.

4.5 Canada-Alberta Crop Insurance Program

4.5.1 Description

The Canadian Crop Insurance Act of 1959 established a joint federal-provincial program for all-risk crop insurance. Prior to 1990, the federal government paid 50% of the insurance premiums for all-risk insurance, including hail, while the provincial government paid administration costs plus additional premium costs for high risk areas. The government contributions kept the farmer's overall share of the insurance premium at less than half of what it would otherwise be. Maximum insurable coverage cannot exceed 80% of the long term average yield for any single crop and, historically, only 60 and 70 percent coverage levels for cereals and oilseeds have been provided.

The crop insurance program is a yield insurance program, not a price or income support policy. Farmer participation is voluntary. The number of participants during 1985-89 has stabilized at about 25,000 farmers. This program has provided crop insurance for about 50% of the cultivated acreage in Alberta, although it typically ranges from a high of 70% of the cultivated acreage in south-central Alberta to a low of 9% in northeastern Alberta (Table 4.5.1 and accompanying Figure 4.5.1).

Table 4.5.1

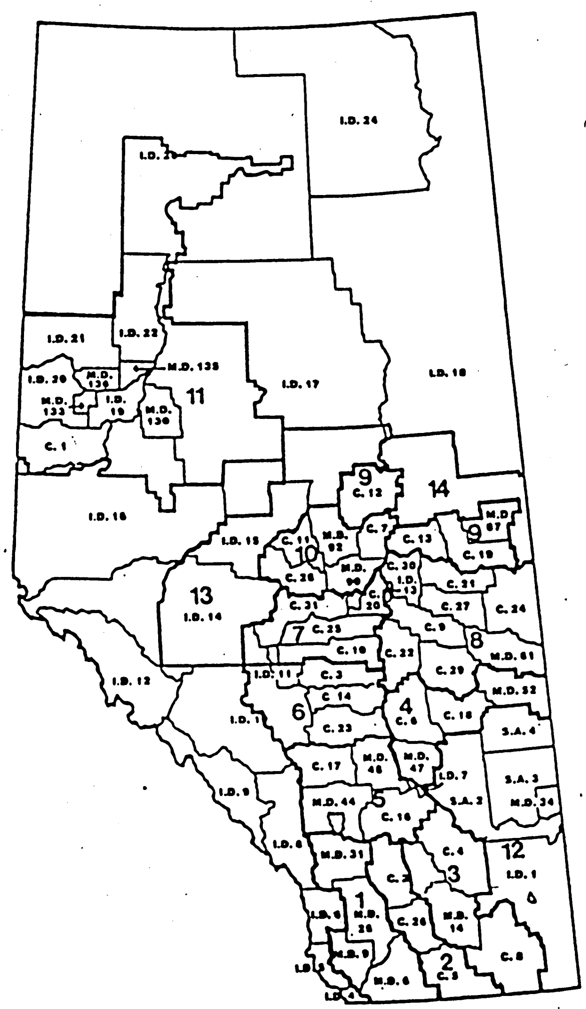
Participation in the Crop Insurance Program, Excluding Forage Programs, 1985-89

Risk Area		% Census "Farmers"	% Crop Area (1986)
2.	Vulcan-Warner	69	68
3.	Taber-Forty Mile	63	52
12.	Special Areas	69	63
1.	High River-Cardston	44	70
4.	Drumheller-Provost	62	56
5.	Calgary North	61	70
8.	Camrose-Vermilion	54	49
6.	Red Deer-Ponoka	39	52
7.	Edmonton South	18	23
9.	Athabasca-St. Paul	21	18
10.	Edmonton North	23	19
11.	Peace River	44	43
13.	Edson-Slave Lake	10	11
14.	Lac La Biche-Cold Lake	9	9
	TOTAL	43	49[a]

[a] In 1988, the forage program would have added 2.9 million acres to the insured total, or 10 percentage points to insured crop area, based on 28 million improved acres in Alberta farms.

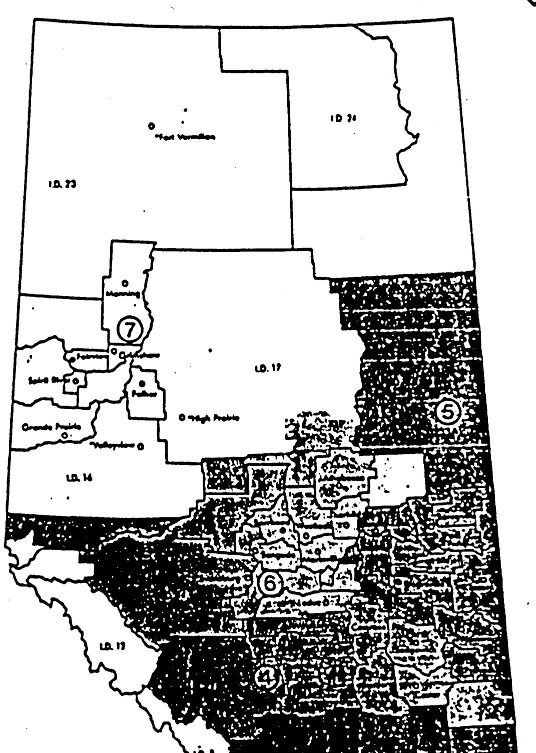
Sources: AHCIC, *Annual Reports*, and *1986 Census of Agriculture*.

Figure 4.5.1
Alberta Hail and Crop Insurance Corporation Supervisory Regions and Crop Insurance Risk Areas



Crop Insurance Risk Areas

1. High River - Cardston
2. Vulcan - Warner
3. Taber - Forty Mile
4. Drumheller - Provost
5. Calgary North
6. Red Deer - Ponoka
7. Edmonton South
8. Camrose - Vermilion
9. Athabasca - St. Paul
10. Edmonton North
11. Peace River
12. Special Areas
13. Edson - Slave Lake
14. Lac La Biche - Cold Lake



Supervisory Regions

4.5.2 Resource Use Issues

An earlier AHCIC review (Schmidt 1986) identified the crop insurance program as having a possible effect on soil degradation in four ways:

a. The program incorporates a subsidy for crops grown on poorer, 'high risk' soils. This might encourage farmers to seed marginal land rather than trying forage rotations, fertilizer application, and weed control that would improve yields and help in soil conservation.

b. The higher coverage available for crops seeded on fallow as opposed to stubble acreage encourages the practise of summerfallowing as opposed to conservation farming practises.

c. The use of area-average coverage would be of greater benefit to poor farm managers and could discourage better farm managers from participating. Rewarding poor management may be a disincentive for following good soil management practises.

d. The provision of coverage for forage crops is a beneficial factor for the encouragement of soil conservation practises.

The first of these potential problems arises because premium costs have been capped at 6 and 8 percent of the 60 and 70% dollar coverage levels respectively so that crop insurance remains "affordable" to farmers throughout Alberta. This distorts relative farm premiums, disguising actuarially sound premium rates which reflect long-tern risk levels.

This policy clearly does have a non-neutral affect on land use because it subsidizes premiums more for farmers on higher risk, low quality land who produce a higher-risk crop (e.g. canola on marginal land in the Peace River area) than for farmers on lower-risk high quality land who produce a lower-risk crop (e.g. barley in South-Central Alberta).

First introduced in 1977, the cost to Alberta taxpayers of this increasingly large subsidy in 1989 was about $7 million, estimated to have gone to the respective AHCIC Supervisory Regions as tabulated in Table 4.5.2 following:

Table 4.5.2

Acres Qualifying for a High Risk Subsidy, 1985 and 1989

Supervisory Region*	1985 Acres (M.)	1985 % Total Insured	1989 Acres (M.)	1989 % Total Insured
South (1)	0.4	15%	1.5	54%
Central (2-6)	0.9	14%	1.8	25%
Northwest (7)	1.5	99%	1.3	99%
TOTAL	2.8	26%	4.6	40%

* For regions, see accompanying Figure 4.5.1.

Source: Basic data from AHCIC, Lacombe, March 1990.

The high risk subsidy is presently applied to virtually all insured crops in Northwest Alberta, the region which typically receives about 50% of the total subsidy. With the advent of the more drought-prone 1980's, the use of the high risk subsidy became necessary to limit farm premium increases for more and more crops and more and more regions throughout Alberta, particularly in the south and southeast.

Because the production of annual crops (particularly canola) on more marginal croplands has been artificially encouraged, a negative impact on soil quality is implied. The real question outstanding is the severity and extent of this degradation.

Regarding the suggestion that the AHCIC rate structure has encouraged the use of more summerfallow, the argument is basically that estimated AHCIC yield differentials between stubble and summerfallow (based on historical time series) are too large, given todays' technology (Heikkila 1986b). But this analysis does not necessarily mean AHCIC policy is in error. These yield ratios are actually a function of both the respective technologies (cost-structures) employed and regional climatic conditions. The relatively dry 1980's, did not favor high input agriculture or summerfallow reductions. Indeed, recent droughts simply accentuated stubble yield variability which should have dictated even higher (actuarially sound) insurance premiums for stubble crops.

The third issue is the proposition that poorer farm managers are more likely to have crop insurance than are good farm managers. Do participants have different land use patterns and/or lower yields? Again, however, the available data is inconclusive. The AHCIC is presently conducting a three year farm survey to verify or refute this hypothesis.

Lastly, insurance coverage for forage crops should encourage production of forage crops and, hence, improved soil conservation. But it is premature to try to evaluate the impact of this policy on the relatively few acres of forage crops insured prior to program changes in 1988. The future impact should be positive, however.

Yet another possible crop insurance issue which might also indirectly impact on the sustainability of agricultural land is tied to the alleged inadequate compensation by the AHCIC for wildlife degradation; a policy which inadvertently could be encouraging more drainage and land clearing on marginal lands to further increase agricultural crop production on more erosion-prone lands. Again, however, this circuitous link to resource sustainability is also very ambiguous.

4.5.3 Quantitative Overview

The focus here is on the two major issues:

- high risk premium (HRS) subsidies which may encourage annual crop production on marginal soils, and
- the alleged bias in favor of crops on summerfallow

4.5.3.1 High Risk Subsidies

Criticism of the high risk subsidy (HRS) is not simply that it is a mechanism which further disguises the real costs of crop production to the producer. Clearly, the federal government's 50% contribution also does that. What is of particular concern is the use of a cap to try to "equalize" premiums between technologies, crops and regions. This does distort production incentives by encouraging annual crop production on more marginal erosion-prone lands. But has this really changed land use patterns?

A recent study in Saskatchewan (Rosaasen, Eley, and Lokken 1990) suggests that the direction of most government programs, including crop insurance even without the HRS, does, indeed, encourage the cultivation of marginal land. Yet other than implying that other government programs, like the WGTA and WGSA, (see elsewhere) have been much more important than crop insurance in this regard, no concrete estimate of the extent of this influence is provided.

Even when considering the additional high risk area subsidies specific to Alberta, the calculations in accompanying Table 4.5.3 suggest that, with the possible exception of the Northwest, the resulting resource distortions probably have not been very great. Two reasons why this may be the case are suggested:

- First, from Table 4.5.3 it can be observed that even in 1989, average premium costs other than those in Northwest Alberta would not have changed very radically even without the HRS:

Table 4.5.3

Role of AHCIC High Risk Subsidies in Total Premium Costs, By Region, 1985-89[a] ($/acre)

	South (Region 1)[b]			Northwest (Region 7)[c]			Other Alberta			Total		
Year	Federal	Provincial	Farmer	Federal	Provincial	Farmer	Federal	Provincial	Farmer	Federal	Provincial	Farmer
1985	3.50	.09	3.40	5.56	2.26	3.30	2.74	.13	2.60	3.31	.41	2.90
	(50)	(1.3)	(48.7)	(50)	(20.3)	(29.7)	(50)	(2.4)	(47.6)	(50)	(6.2)	(43.8)
1986	4.34	.31	4.03	5.95	2.39	3.55	3.16	.15	3.01	3.83	.48	3.34
	(50)	(3.6)	(46.4)	(50)	(20.1)	(29.9)	(50)	(2.4)	(47.6)	(50)	(6.3)	(43.7)
1987	3.81	.46	3.35	4.82	1.69	3.12	2.55	.10	2.45	3.18	.41	2.76
	(50)	(6.0)	(44.0)	(50)	(17.6)	(32.4)	(50)	(2.0)	(48.0)	(50)	(6.5)	(43.5)
1988	3.54	.38	3.16	5.80	2.47	3.33	2.95	.15	2.79	3.43	.49	2.94
	(50)	(5.4)	(44.6)	(50)	(21.3)	(28.7)	(50)	(2.6)	(47.4)	(50)	(7.1)	(42.9)
1989	5.31	.74	4.56	6.98	2.75	4.23	2.67	.20	2.46	4.59	.64	3.95
	(50)	(7.0)	(43.0)	(50)	(19.7)	(30.3)	(50)	(3.8)	(46.2)	(50)	(7.0)	(43.0)
Average	(50)	(4.7)	(45.3)	(50)	(19.8)	(30.2)	(50)	(2.6)	(47.4)	(50)	(6.6)	(43.4)

[a] Provincial = High Risk Subsidy and excludes all administrative costs of program. Bracketed numbers indicate percentage shares.

[b] Approximate Risk Area premiums aggregated into Administrative Areas using relative 1986 municipal areas in crops.

[c] Assume Risks Area II = Administrative Area 7.

Source: Basic data from AHCIC, 1990.

Region	With HRS ($/acre)	W/o HRS	% Change
South	4.56	5.30	+14%
Central	2.46	2.66	+ 8%
Northwest	4.23	6.98	+65%
TOTAL	3.95	4.59	+16%

- Second, in the context of total crop production costs where cash costs are typically in the $40-$90/acre range, it is clear that say, a $1.00/acre change in costs would not likely prompt a major expansion in the cultivated acreage utilized for annual crop production.

At the same time, it must be recognized that these estimates are averages across all crops within a region; calculations which disguise differential subsidy levels for various crops within a region. Considering canola on stubble in Northwest Alberta, for example, suggests that the HRS really does make a major difference to premium costs in some circumstances. In this case, we have the following premium differences:[10]

Soil Class	With HRS ($/acre)	W/o HRS	% Change
B	4.70	8.70	+85%
C	4.20	8.70	+107%
D	3.65	8.70	+138%

These changes, in the context of Table 4.5.4, translate into a substantial impact on the "bottom line":

Soil Class	Return to Capital ($/acre) With HRS	W/o HRS
B	18.98	14.98
C	8.98	4.48
D	(3.77)	(8.82)

Thus, in this particular instance, the HRS could well have prompted some Northwest Alberta farmers to augment cultivation of more marginal erosion-prone lands. On the basis of this data, however, we are only able to tentatively suggest that the aggregate impact of the HRS on marginal land use in Alberta (exclusive of other influences) has probably been relatively small. Isolating and quantifying the physical extent of this influence would require additional data and a more in-depth regional analysis.

10 Source: 1988 AHCIC coverage and premium rates. Without the federal governments 50% premium contribution, the total premium cost (which is actuarily sound) would be $17.40/acre.

Table 4.5.4

The Economics of Canola Production on Stubble in the Peace River Region, 1988

Item	Soil Class B	Soil Class C	Soil Class D
Yield (bus.)	15.4	13.9	12.0
Price/bushel	7.00	7.00	7.00
Gross Return	107.80	97.30	84.00
Seed/Twine		4.77	
Fertilizer		20.76	
Chemicals		12.10	
HAIL/CROP INSURANCE[a]	4.70	4.20	3.65
Fuel		6.11	
Repairs - Machine		12.24	
Repairs - Buildings		0.70	
Utilities		1.83	
Custom Work & Spec. Labor		3.18	
Miscellaneous		2.16	
Operating Interest Paid		1.09	
Paid Labor		3.58	
Family & Operator Labor		15.60	
Variable Costs	88.82	88.32	87.77
Direct Cash Costs	73.22	72.72	72.17
Cash Rent/Crop Share		3.53	
Taxes & Insurance		2.65	
Equip. & Bldg. Deprec'n.		27.81	
Paid Capital Interest		11.83	
Total Capital Costs	45.82	45.82	45.82
TOTAL COSTS	134.14	134.14	134.14
Return to Capital or Contribution to Margin	18.98	8.98	(3.77)
Return to Equity	(26.34)	(36.84)	(50.14)
Return to Investment	(14.51)	(25.01)	(38.31)

[a] Premium costs taken from AHCIC data for 70% stubble coverage, 1988.

Source: AHCIC (yield estimates) from Alberta Agriculture, *Costs and Returns for Crop Production in Alberta, 1988*, Edmonton, 1989.

4.5.3.2 Premium/Payout Bias for Summerfallow

Regarding the suggestion that AHCIC premium costs and higher potential payouts for summerfallow artificially stimulate maintaining more summerfallow than would otherwise be the case, the existing evidence appears even more inconclusive. Data which seemingly gives some support to this contention are provided in Table 4.5.5 following:

Table 4.5.5

Reasons for Summerfallowing (% Respondents)

Reasons	Percent Response
Weed Control	62
Moisture Conservation	46
Lower Fertilizer Costs	39
Reduced Risk from Drought	35
Giving the Land a Rest	33
Crop Insurance Benefits	8

Source: Jensen, T. 1988. *Conservation Tillage Survey*. Edmonton, Alberta Agriculture, November.

Data such as that above may disguise more than it reveals. An earlier more comprehensive study of why Alberta farmers' summerfallow (Environment Council of Alberta 1980) elicited no such response from a similar farm survey. Indeed, it may be noteworthy that the ranking of the first five regions for summerfallowing were virtually identical in both surveys. The sixth reason identified by ECA 1980 was "income stability", not "crop insurance benefits", a subtle but perhaps important semantic difference. Yet other data, however, also continues to fuel this conjecture. The data tabulated in accompanying Table 4.5.6. is illustrative.

Crops on summerfallow are, indeed, generally insured to a far greater extent than stubble crops. But this may arise simply because the respective premium-payout ratios (based on AHCIC risk calculations) are perceived as favoring summerfallow. Or perhaps its because higher-risk higher-valued crops are more often grown on summerfallow (e.g. canola) and/or because more risk-averse farmers (who are more prone to buying crop insurance) typically maintain relatively more summerfallow as yet another form of crop insurance. In any event, and whatever the precise reason(s) for this differential crop insurance coverage, there appears to be little or no *a priori* evidence to suggest that crop insurance actually encourages the practice of summerfallowing. Simply put, the correlation as per Table 4.5.6. does not, in itself, imply causality.

Table 4.5.6

Crop Insurance Coverage on Summerfallow and Stubble Crops in Alberta, 1986 (Thousand Acres)

	Area With Crop Insurance		Total Crop Area		% Area Insured	
Risk Area	Fallow Crops	Stubble Crops	Fallow Crops	Stubble Crops	Fallow Crops	Stubble Crops
1	125	985	146	1,442	86	68
2	435	467	498	833	87	56
3	495	388	702	999	71	39
4	272	572	398	1,101	68	52
5	355	1,181	455	1,743	78	68
6	38	791	66	1,521	58	52
7	42	229	85	1,098	49	21
8	319	1,574	692	3,157	46	50
9	48	132	156	832	31	16
10	62	208	145	1,296	43	16
11	433	1,034	740	2,650	59	39
12	669	274	863	628	78	44
13	7	14	107	92	7	15
14	4	12	28	155	7	8
TOTAL	3,304	7,861	5,081	17,547	65	45

Sources:

(1) Crop insured acreages obtained directly from AHCIC personnel, Lacombe, March 1990.

(2) Total crop acreages based on regional data from the *1986 Census of Agriculture for Alberta*, Alberta Agriculture, Edmonton, August 1987.

(3) Regional summerfallow acreages for 1985 were estimated using regional 1986 census data [13] and a 1985 total summerfallow estimate as indicated in the *1986 Agricultural Statistics Yearbook*, Alberta Agriculture, Edmonton, 1987. Factor = .9667.

4.5.4 Survey Responses

Table 4.5.7 indicates that about two-thirds of all survey respondents grow crops covered by crop insurance, while about 1 out of 5 of these farmers indicate that their management decisions have been influenced by their purchases of crop insurance.

Table 4.5.8 following, provides a general indication of how management has apparently been affected by crop insurance program. For the small minority which indicated their management was affected by the crop insurance program (less than 20%), this most frequently involved increasing their cultivated acreage or increasing inputs per acre. Note, however, that this was not particularly prevalent in the Peace River Region (an *a priori* concern) while there is apparently almost no affect in the Central Gray Region.

Table 4.5.7

Survey Farmers Whose Management Decisions Were Affected by Crop Insurance

Region	Purchasing Insurance		Management Affected	
	Number	Percent[a]	Number	Percent
South	251	80.4	59	22.6
Central-Black	204	61.3	36	16.7
Central-Gray	34	31.8	2	4.4
Peace River	72	57.6	16	21.3
All Regions	565	63.9	114	18.9

[a] Compare with Table 4.5.1. Sample survey from CWB permit book holders (about 46,000) versus census farms (about 58,000). Also see Section 1.2.3.

Table 4.5.8

Ways in Which Crop Insurance Affected Farmers' Own Operations in the 1980's

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	260	20 (35.7)	36 (64.3)	0 (0.0)
Summerfallow acreage	263	3 (5.7)	23 (43.4)	27 (50.9)
Forage acreage	265	4 (7.8)	45 (88.2)	2 (3.9)
Inputs per acre	262	29 (53.7)	17 (31.5)	8 (14.8)
Tillage operations	262	7 (13.0)	31 (57.4)	16 (29.6)
Livestock production	263	13 (24.5)	38 (71.7)	2 (3.8)

Region - Central Black	Number of Responses (% of Those Responding)			
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	299	12 (34.3)	21 (60.0)	2 (5.7)
Summerfallow acreage	301	4 (12.1)	21 (63.6)	8 (24.2)
Forage acreage	305	6 (20.7)	20 (69.0)	3 (10.3)
Inputs per acre	301	15 (45.5)	11 (33.3)	7 (21.2)
Tillage operations	303	8 (25.8)	17 (54.8)	6 (19.4)
Livestock production	304	8 (26.7)	18 (60.0)	4 (13.3)

Region - Central Gray	Number of Responses (% of Those Responding)			
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	106	0 (0.0)	1 (50.0)	1 (50.0)
Summerfallow acreage	106	0 (0.0)	1 (50.0)	1 (50.0)
Forage acreage	106	1 (50.0)	1 (50.0)	0 (0.0)
Inputs per acre	106	1 (50.0)	0 (0.0)	1 (50.0)
Tillage operations	106	0 (0.0)	2 (100.0)	0 (0.0)
Livestock production	106	1 (50.0)	1 (50.0)	0 (0.0)

Region - Peace River	Number of Responses (% of Those Responding)			
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	108	8 (44.4)	10 (55.6)	0 (0.0)
Summerfallow acreage	109	2 (11.8)	11 (64.7)	4 (23.5)
Forage acreage	110	5 (31.3)	8 (50.0)	3 (18.8)
Inputs per acre	108	9 (50.0)	8 (44.4)	1 (5.6)
Tillage operations	108	3 (16.7)	13 (72.2)	2 (11.1)
Livestock production	114	2 (16.7)	10 (83.3)	0 (0.0)

Province Summary	Number of Responses (% of Those Responding)			
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	773	40 (36.0)	68 (61.3)	3 (2.7)
Summerfallow acreage	779	9 (8.6)	56 (53.3)	40 (38.1)
Forage acreage	786	16 (16.3)	74 (75.5)	8 (8.2)
Inputs per acre	777	54 (50.5)	36 (33.6)	17 (15.9)
Tillage operations	779	18 (17.1)	63 (60.0)	24 (22.9)
Livestock production	787	24 (24.7)	67 (69.1)	6 (6.2)

Source: Questionnaire responses.

The survey results which isolate the management responses of those farmers with and without a High Risk Subsidy nonetheless hint that the HRS may be more detrimental to the long-term sustainability of agricultural land base. For example, a much larger proportion of *perceived* HRS recipients (30.6 percent) indicated their management decisions were affected by crop insurance than was the case for non-HRS recipients (13.6 percent). Since the HRS is a hidden subsidy and the number of respondents in this particular instance was relatively small, however, this apparent difference may or may not be statistically significant.

Finally, and perhaps somewhat surprisingly (in light of the conclusions in Schmidt 1986) farmers' responses concerning the overall effect of crop insurance on the quality of neighboring agricultural land are almost equally benign (Table 4.5.9). Province-wide, over sixty percent of farmers believe there has been no affect on land quality. At the same time, there is a small minority (by about a 2:1 margin) who still believe the net impact on land quality has been negative. Ironically, these farmers are most frequently found where crop insurance coverage is relatively limited (Central Gray) while in areas where relatively more crop insurance is purchased, the effect is more likely to have been perceived as being both negative and positive.

Table 4.5.9

Farmers' Estimates of Effects of Crop Insurance on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
-3	32 (10.8)	15 (4.8)	11 (11.3)	9 (7.8)	67 (8.1)
-2	26 (8.8)	14 (4.5)	6 (6.2)	11 (9.5)	58 (7.0)
-1	27 (9.1)	20 (6.4)	6 (6.2)	14 (12.1)	67 (8.1)
No Effect	147 (49.7)	230 (73.7)	69 (71.1)	68 (58.6)	520 (62.8)
+1	39 (13.2)	8 (2.6)	1 (1.0)	6 (5.2)	27 (3.3)
+2	12 (4.4)	8 (2.6)	1 (1.0)	6 (5.2)	27 (3.3)
+3	13 (4.4)	8 (2.6)	1 (1.0)	3 (2.6)	25 (3.0)
Strongly Positive					
No Response	20	22	11	10	63
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.5.5 Alberta Hail and Crop Insurance Results

The Alberta Hail and Crop Insurance Program is a well-established and widely-utilized program which has now been in operation for almost 30 years. During its evolution, it has sometimes been subject to criticism focused on land management issues.

There is, however, very little concrete evidence presented in the foregoing to support the contention that the *present* AHCIP has had a major influence on the rate of agricultural land degradation in the province. Based on the farm survey responses of the farmers who actually purchase crop insurance (about 60% of all farmers province-wide) only about 1 out of every 5 believes it actually affects the way he manages his land. And even with regard to neighboring land, only 2 out of every 5 farmers think the program has somehow affected land quality in their area. The most frequently cited impacts are an increase in the cultivated acreage (presumably on to more marginal crop land) and an increase in fertilizer and herbicide use.

The hypothesis that the AHCIP somehow inflates the summerfallow acreage in Alberta is not supported by the survey results. Based solely on this information, one can at least infer that:

- since only about 60% of all farmers purchase all-risk crop insurance for at least some of their crops, and
- since only about 20% of this 60% believe the program has any impact on their land management decisions, and
- since even identified impacts are apparently both positive (more inputs and less summerfallow) and negative (expanding cultivation on to more marginal crop land).

the net province-wide impact on land degradation should, at the very least, be relatively small.

Our quantitative overview generally reinforces this overall assessment. Specific negative impacts suggested are region-specific and are apparently obscured by the level of aggregation considered herein.

Follow-up telephone interviews with 20 randomly selected survey respondents closely paralleled the findings of the mail-out survey. Almost all of these farmers (who generally purchased crop insurance) also felt that crop insurance had little or no impact on their land management decisions because "... you can't make money farming crop insurance." And, similarly, the most frequent management response of farmers to the purchase of crop insurance was to increase either the quantity or quality of fertilizers and herbicides utilized in crop production; practices which should have impeded the rate of land degradation. Expansion on to more marginal land was only mentioned once. Conversely, most farmers interviewed who didn't purchase crop insurance felt that the program was abused by, say, 5 percent of insured producers; most often by substituting crop insurance for fertilizer and herbicides.[11] This perception would imply a small but opposite (adverse) long-term impact on land quality. The high risk subsidy was initially identified as a possible significant aspect of the crop insurance program with respect to erosion. That aspect of the crop insurance program appeared to be small enough that it did not influence results at the level of aggregation involved in this study. Thus, the operative word in terms of the net province-wide impact is "small".

11 Largely prior to the recent AHCIC changes towards individual coverage.

4.6 Special Canadian Grains Program (SCGP)

4.6.1 Description

The first federally-sponsored Special Canadian Grains Program was announced in December of 1986 as a once-only initiative to help farmers cope with low world grain prices. The extremely depressed market for grains and oilseeds was the result of an increasingly acute trade subsidy war between the United States and the European Economic Community. This program (with payments being made in 1987) had a national upper limit of $1 billion, out of which some 47,438 Alberta farmers ultimately received about $261.8 million. It covered at least 85% of all farmers in the province.

The payout procedure for the SCGP in 1986 involved three variables:

(1) The acreage each farmer had seeded to each of the eligible crops;

(2) An average regional yield for each crop, determined for the smallest possible area for which data could be collected.

(3) A payout rate per bushel whereby the total over all crops and farmers covered would be close to, but not exceed, the total monetary allotment for the Program.

Thus:

Producer payment = Sum over all crops of (1986 eligible acres of each crop) x (average regional yield for each crop x (assistance rate)

The list of eligible crops, the regional average yields, and the assistance rates employed in this formula are indicated in accompanying Tables 4.6.1 and 4.6.2. Note, in particular, that the eligible crops which qualified for the 1986 SCGP excluded all forage crops, green manure crops, specialty crops, and summerfallow.

Table 4.6.1

Initial Assistance Rate Estimates, SCGP, 1986

Commodity	$/tonne	$/bushel
Wheat	18.00	.48
Oats	12.00	.18
Barley	13.00	.28
Rye	9.00	.22
Flax	20.00	.50
Canola	22.00	.49
Corn (grain)	14.00	.34
Soybeans	7.00	.19
Sunflowers	20.00	.27
Mixed grains	12.35	.23

Source: Program data.

Table 4.6.2

Alberta - Average Yields For SCGP, 1986

(bushels/acre)

Best 3 of 5 Years (1981 to 1985)

Risk Area	Wheat	Barley	Oats	Rye	Flaxseed	Canola	Sunflowers	Corn
1	31.80	49.68	55.35	32.92	19.92	21.03	69.43[d]	81.69[d]
2	32.96	49.69	52.62	36.44	18.28	23.18	69.43	81.69
3	33.86	51.08	53.48	31.23	26.75	26.18	69.43	81.69
4	31.16	50.28	46.79	27.78	24.08	23.10	69.43	81.69
5	39.75	60.25	77.37	40.87	21.34	27.01	69.43	81.69
6	42.83	58.53	70.44	27.60[a]	16.86[b]	25.00	69.43	81.69
7	41.83	58.83	65.70	27.60[a]	16.86[b]	28.00	69.43	81.69
8	31.61	48.01	51.28	27.60[a]	16.86[b]	22.38	69.43	81.69
9	33.82	47.25	59.03	27.60[a]	16.86[b]	21.25	69.43	81.69
10	39.51	56.60	67.07	27.60[a]	16.86[b]	24.47	69.43	81.69
11	32.06	37.47	51.23	27.60[a]	14.41	15.18	69.43	81.69
12	27.43	41.53	39.60	21.53	14.01	17.46	69.43	81.69
13	37.00	52.72	55.48	27.60[a]	16.86[b]	17.75[c]	69.43	81.69
14	30.11	41.77	58.04	27.60[a]	16.86[b]	17.75[c]	69.43	81.69

[a] Risk Areas 6, 7, 8, 9, 10, 11, 13 and 14 combined due to limited data.

[b] Risk Areas 6, 7, 8. 9, 10, 13 and 14 combined due to limited data

[c] Risk Areas 13 and 14 combined due to limited data.

[d] Limited acreage, therefore, only all-province yield available.

Source: Alberta Hail and Crop Insurance Corporation.

Program assistance was provided in two payments. The first payment (about 1/3 of the total) was made during January-March, 1987. The second payment (the remaining 2/3) was made in May-June 1987. The average total payment per farmer was about $5,500 and the maximum allowable was $25,000 per farmer.

The follow-up 1987 SCGP was a somewhat more comprehensive program which had a national upper limit of $1.1 billion. In this case, some 50,521 Alberta farmers ultimately received about $300.6 million. This covered at least 90% of all Alberta farmers.

Under this program, producers were paid according to the following formula:

Producer payment = Sum over all crops of ((1987 eligible acres of each crop) x (average regional yield for each crop) x (assistance rate adjusted for summerfallow)) + (summerfallow assistance rate for each area) x (one-third of 1987 summerfallow acres for area).

This time, eligible crops also included specialty crops (Table 4.6.3) and one-third of the summerfallow acreage also received a payment (Table 4.6.4). Assistance rates were, moreover, adjusted to pay out a total of $1.1 billion with the inclusion of summerfallow in the payout formula, while long-term average regional yields were updated and further refined (Table 4.6.5). A payout was also made for alfalfa if producers could verify that they had delivered to a processing plant. Yet another adjustment provided for higher assistance rates to farmers with irrigation. All forage crops and green manure crops were once again excluded from the payout formula.

Like the first program, the 1987 SCGP payouts were again made in two installments; about 1/3rd in May 1988 and about 2/3rds in July 1988. In this case, the average total payment received was about $6,000 per farmer--an amount which was again capped at a maximum $25,000 per farmer.

Table 4.6.3

Initial Assistance Rate Estimates, SCGP, 1987[a]

Crop	$/tonne	$/bu.	¢/lb.
General:			
Wheat	14.65	0.40	
Oats	7.38	0.12	
Barley	14.97	0.33	
Mixed grains	11.63	0.22	
Rye	4.17	0.11	
Grain corn	10.37	0.26	
Soybeans	0.42	0.01	
Flax	26.02	0.66	
Canola-rapeseed	16.90	0.38	
Sunflower seed	5.09	0.07	
Special Crops:			
Lentils			1.66
Canaryseed			1.11
Safflower			0.23
Fababeans			0.79
Mustard			1.28
Dry beans			2.03
Dry peas		0.52	
Triticale		0.33	
Buckwheat		0.66	

[a] Adjusted for summerfallow.

Table 4.6.4

Assistance Rates for Summerfallow, SCGP, 1987

Risk Area	$/Acre
1	4.80
2	4.39
3	4.11
4	4.39
5	5.89
6	5.77
7	5.73
8	4.43
9	4.32
10	5.42
11	3.65
12	3.43
13	4.24
14	3.24

Table 4.6.5

Alberta Average Yields for SCGP, 1987
(mt/acre)
Best 3 of 6 Years (1981 to 1986)

Risk Area	Wheat	Barley	Oats	Rye	Flaxseed	Canola	Sunflowers	Corn	Soybeans	Mixed Grains
01	0.897	1.112	0.915	0.904	0.481	0.534	0.524	2.286	0.57	1.014
02	0.868	1.028	0.813	0.926	0.461	0.572	0.524	2.286	0.57	0.920
03	0.817	0.958	0.787	0.860	0.428	0.490	0.524	2.286	0.57	0.872
04	0.911	1.232	0.871	0.769	0.612	0.570	0.524	2.286	0.57	1.052
05	1.163	1.404	1.203	1.070	0.538	0.636	0.524	2.286	0.57	1.304
06	1.220	1.350	1.119	0.703	0.465	0.567	0.524	2.286	0.57	1.435
07	1.173	1.370	1.064	0.703	0.465	0.649	0.524	2.286	0.57	1.217
08	0.926	1.202	0.911	0.703	0.465	0.517	0.524	2.286	0.57	1.057
09	0.920	1.085	0.910	0.703	0.465	0.482	0.524	2.286	0.57	0.998
10	1.075	1.283	1.074	0.703	0.465	0.555	0.524	2.286	0.57	1.178
26[a]	0.889	0.899	0.881	0.703	0.393	0.393	0.524	2.286	0.57	0.890
27[a]	0.859	0.802	0.763	0.703	0.393	0.334	0.524	2.286	0.57	0.782
12	0.733	0.866	0.619	0.547	0.247	0.459	0.524	0.286	0.57	0.743
13	1.007	1.225	0.890	0.703	0.465	0.436	0.524	2.286	0.57	1.058
14	0.819	0.973	0.895	0.703	0.465	0.436	0.524	2.286	0.57	0.934

[a] Risk Area 11.

Source: Alberta Hail and Crop Insurance Corporation.

4.6.2 Resource Use Issues

Issues regarding resource-use adjustments in response to the SCGP in 1986 and 1987 (actually 1987 and 1988) generally relate to the following:

- The exclusion of forage (hay, silage and greenfeed) and green manure crops from the program which might possibly have discouraged production of these conservation-enhancing crops in future years. This decision was apparently made (twice) for four basic reasons: (1) simplicity of program administration with the intention to send money to producers as quickly as possible; (2) a difficulty in determining yields for forages since so few producers could or did participate in a forage crop insurance program; (3) a policy response that there was no evidence that hay, silage, or greenfeed prices had been affected by international subsidies; and (4) a broader concern that the extension of the program to forage and silage producers would 'dilute' payments to grain farmers.
- The exclusion of specialty crops from the 1987 program which could have: (1) discouraged diversification out of annual grain and oilseed production in subsequent years, which, in turn, could have (2) reduced the subsequent production of more conservation-friendly nitrogen-fixing legumes.
- The inclusion of summerfallow in the 1987 program which might have induced farmers to maintain more summerfallow in the future.
- The income stimulus in both 1987 and 1988 may have encouraged continued (or even expanded) annual grain and oilseed production on more marginal erosion-prone agricultural lands. (This is generally land which critics argue should never have been cultivated; land which was cultivated during the economically buoyant 1970's).

Conversely, it is generally acknowledged that this income infusion into the agricultural community did provide farmers with more liquidity, thus helping to maintain input levels (especially fertilizer and pesticide levels) and soil maintenance.

4.6.3 Quantitative Overview

For all practical purposes, the SCGP was universal in its application. Some 47,000-51,000 farmers (the number of SCGP participants in Alberta) included virtually every commercial farmer in Alberta.

Unquestionably, the SCGP also had a very substantial impact on gross and net income levels in the agricultural sector in both 1987 and 1988 (Table 4.6.6). The estimates are as follows:

Item/Year	1987	1988
Gross Income	+ 7%	+ 7.3%
Net Income	+ 69%	+ 48%

According to Deloitte-Touche (1987, 31), this windfall was (at least in 1987) largely used to purchase inputs (56%) and to pay off operating loans (32%).

In this context, therefore, there are two central issues regarding possible resource degradation:

- violation of the resource-neutrality objective?
- artificial signals to continue "over-farming" marginal agricultural land?

These issues are only valid concerns if, in fact, the program was not perceived by farm operators as being a one-time income transfer--a point which seems to have been confirmed an earlier evaluation of the initial SCGP (Deloitte-Touche 1987, 41).

> "A legacy of the (1986) SCGP program, the prevailing market conditions, and the perception of the federal government's current position formed, among the majority of the producer [survey] respondents, the basic expectation that there <u>will be</u> further special financial assistance. The remainder felt that there <u>may be</u> further assistance. Only one lone voice in the survey felt that there would not be further assistance. Producers in Western Canada were more optimistic, or perhaps, more strident about the prospects and the need for special assistance and the level of further payments...

Table 4.6.6

Role of the SCGP in Net Farm Income, Alberta, 1986/87 and 1987/88

Item	1986	1987	1988	1989P
Wheat	517,000	560,000	694,000	738,000
Oats	17,000	19,000	66,000	90,000
Barley	318,000	232,000	256,000	414,000
CWB Advances and Deferments (net)	24,000	-3,000	-58,000	-1,000
W.G.S.A. Payments	225,000	368,000	180,000	80,000
Special Canadian Grains Program	--	261,800	300,600	--
Crop Insurance	160,000	135,000	173,000	151,000
Rye	5,000	5,000	8,000	6,000
Flaxseed	6,000	6,000	8,000	8,000
Canola	268,000	315,000	455,000	370,000
Sugar Beets*	14,000	13,000	19,000	19,000
Potatoes	31,000	35,000	40,000	40,000
Vegetables	29,000	30,000	31,000	33,000
Flori. and Nursery	24,000	29,000	34,000	37,000
Other Crops	70,000	60,000	82,000	70,000
Def. and Supp.	105,000	20,200	13,400	114,000
TOTAL CROPS	1,813,000	2,086,000	2,302,000	2,169,000
TOTAL LIVESTOCK	1,947,000	1,926,000	2,139,000	2,294,000
TOTAL FARM CASH RECEIPTS	3,760,000	4,012,000	4,441,000	4,463,000
Total Operating Expenses	2,750,000	2,729,000	2,873,000	3,078,000
Net Cash Income	1,010,000	1,283,000	1,568,000	1,385,000
Income in Kind	19,000	22,000	21,000	21,000
Depreciation Charges	670,000	666,000	667,000	676,000
REALIZED NET INCOME	359,000	639,000	922,000	730,000

P = preliminary; * deficiency payments included in commodity receipts.
Source: Alberta Agriculture/Statistics Canada, Edmonton, December 1989.

> The basic perception [regarding further assistance] was that the prospective assistance would be somewhat greater or about the same as the 1986/87 assistance level. Some producers felt that it would be much greater while only a few thought it would be somewhat less. The most prevalent perception was that there will be a somewhat greater payment."

Thus:

- Can we observe aggregate cropping pattern changes during 1977/78 which might be attributed to the SCGP?
- Was there any change in the summerfallow acreage as a result of the SCGP?
- Was there more intensive use of marginal agricultural land because of the SCGP?

4.6.3.1 Cropping Patterns/Summerfallow

Employing a somewhat over-simplified decision-making framework, it is hypothesized that if relative crop prices were greatly affected by the SCGP, then cropping patterns might have been impacted. The calculations in Table 4.6.7 suggest, however, that at least for the basic crops it is very doubtful if the SCGP had any major impact on cropping patterns in Alberta.

Reference to acreage changes during 1986-89 are generally consistent with this thesis. While we might have expected (because of SCGP) decreases in the acreage of forage crops in both 1987 and 1988, we actually saw strong acreage increases in these crops. Similarly, although specialty crops and summerfallow were excluded from the initial SCGP payouts, these acreages also continued to climb. This data doesn't unambiguously demonstrate that there was no SCGP impact on cropping patterns and summerfallow acreages. But at the very least it suggests that changing prices and marketing conditions negated any possible adverse impact that might have occurred.

An earlier farm survey (with 181 respondents) which asked how the initial SCGP would impact on their crop and livestock activities generated a similar response (Deloitte-Touche 1987, 34, 39):

> "The impact of the program was seen to be relatively small in terms of its affect on 1987/88 cropping and stocking activity. Less than 10 percent of producers indicated that the program had any impact on their cropping activities and only 1 percent indicated any impact on their livestock activities. The primary impact was in the area planted with program crops. That is, the program prevented some shift into other cropping activities and resulted in a slightly greater acreage of program crops, and a lower summerfallow, and, to a lesser extent, special crop acreage than would have been the case in the absence of the program. Notwithstanding this impact, the general direction of cropping activities on respondent farms was a shift from program crops and into summerfallow and special crops. The area of summerfallow and special crops increased by some 11 and 68 percent respectively on respondent farms... It is apparent that producers were paying much more attention to the market place than the prospects of future payments..."

The authors thus conclude:

> "The [initial] SCGP had relatively little influence on the more fundamental operational decisions to date. Specifically, it has had minimal impact on decisions to purchase additional land, increase or decrease capital assets, or increase or decrease rented acreage. Indeed, it has been somewhat instrumental in stabilizing or maintaining a *status quo* in this regard. Decisions taken in this area, to date, are largely influenced by market conditions. Nevertheless, the program had a modest impact on restricting diversification of farming activities into other enterprises and other cropping activities. The acreage and production of program crops is somewhat higher than would have been the case in the absence of SCGP. That is, lower acreages of program crops (perhaps in the order of 1-2 percent) and lower levels of fertilizer and chemicals use and, hence, lower outputs would have prevailed under these circumstances. Nevertheless, the marketplace seems to have been the dominant force in dictating cropping decisions on respondent farms" (Deloitte-Touche 1987, v-vi).

In terms of the SCGP extension (1987/88), the amendments to include specialty crops and summerfallow in the payout formula provided even less impetus for subsequent land use changes from occurring as a direct response to the program.

Table 4.6.7

Grain and Oilseed Prices With and Without the SCGP ($/acre)

Basic Crops	1986/87 W/o SCGP	1986/87 With SCGP	1986/87 % Change	1987/88 W/o SCGP	1987/88 With SCGP	1987/88 % Change
Wheat	2.55	3.03	+ 19%	3.04	3.44	13%
Oats	1.06	1.24	+ 17%	1.39	1.51	9%
Barley	1.55	1.83	+ 18%	1.45	1.78	23%
Rye	1.63	1.85	+ 13%	2.13	2.24	5%
Flax	4.34	4.84	+ 11%	5.39	6.05	12%
Canola	4.47	4.96	+ 11%	5.83	6.21	7%
Mixed Grains	1.43	1.66	+ 16%	1.58	1.80	14%

Source: Basic price data from Alberta Agriculture. SCGP payments from Table 4.6.1 and 4.6.3, respectively.

Table 4.6.8

Agricultural Land Use in Alberta, 1986-89 (thousand acres)

Land Use	1986	1987	1988	1989
Cereals[a]	13,566.2	14,290.0	13,310.0	15,560.0
Canola/Flax	2,887.3	2,910.0	3,550.0	2,780.0
Corn	7.2	12.0	9.3	n.a.
Special Crops[b]	38.5	117.6	146.8	n.a.
Fodder Corn	21.8	18.0	19.0	n.a.
Tame Hay	3,734.1	4,350.0	4,650.0	n.a.
Other	2,386.0	n.a.	n.a.	n.a.
Summerfallow	5,256.0	5,300.0	5,350.0	4,950.0
TOTAL	22,641.1	n.a.	n.a.	n.a.

[a] Wheat, oats, barley and rye.

[b] Lentils, dry beans and dry peas.

Source: *1986 Census of Agriculture* (1986), *Agriculture Statistics Yearbook* (1987-88), and personal correspondence with the Statistics Branch, Alberta Agriculture, April 1990 (1989).

4.6.3.2 Agricultural Expansion

There is no macro-secondary data available which might help quantify agricultural expansion effects, if any. In all likelihood, despite the SCGP, the generally depressed market conditions in agriculture continued to dictate a retrenchment of the farm sector. This is reflected in summerfallow acreage increases during 1984-88. Other indicators, such as the decreasing demand for Crown land for agricultural purposes, are equally suggestive:

Crown Land Dispositions, Alberta
('000 acres)

Year	Total Dispositions
1985	112
1986	107
1987	52
1988	77
1989	73

Source: Table 4.8.1.

4.6.3.3 Summary

In summary, it seems reasonably certain that the SCGP in both 1987 and 1988 probably had a positive net impact on the agricultural land base. That is to say, having discounted the possibility of major negative impacts, the positive role the SCGP played in at least maintaining the *status quo* must be highlighted--the most obvious of which was to discourage even more land from being summerfallowed in 1987 and 1988 respectively. Based on a recent estimate of the acreage elasticity of summerfallow with respect to crop prices (MacGregor and Graham 1988)[12], these calculations are as follows:[13]

Net Summerfallow Acreage Reduction Due to SCGP = (Elasticity) (Crop Price Change) (Summerfallow Acreage) $_{t-1}$ - (Actual Change)

1987: NSAR = -.24 (-.17) (5,256,000) - 44,000
= 214,445 - 44,000
= **170,000** acres

1988: NSAR = -.24 (-.14) (5,300,000) - 50,000
= 178,000 - 50,000
= **128,000** acres

Note, however, that these are not long-term summerfallow reductions; they only apply to the specific years in question; their magnitudes diminishing thereafter. Based on earlier experience with LIFT, it was therefore assumed this impact would be 100%, 80%, 60%, 40%, and 20% over a 5-year period.

Given these implied changes in crop rotations and an ever-diminishing impact, the province-wide implications for soil conservation were then generated using the EPIC simulator. The projected positive impact is minute; perhaps 0.15 percent of all wind and water erosion in the province over 50 years. During the actual 5-year program impact period, however, province-wide soil erosion might diminish as much as 2.4 percent; about 3.6 percent in the South. If a 1 in 5 year *ad hoc* pay-out was eventually built into farmer expectations, these larger figures would more accurately reflect program impacts.

12 Note: Annual adjustment is assumed to be 1/5 of the 5-year responses indicated.

13 Crop price change = subsidy as per Table 4.6.7.

4.6.4 Survey Results

Table 4.6.9 indicates that about 44 percent of the survey respondents who received a payment from the initial (1986) SCGP expected a future payment. About 25 percent indicated having also made a management change due to SCGP. Those changes are outlined in Table 4.6.10. Prominent effects include more inputs per acre, possibly less fallow acreage, and some indication of greater cultivated (cropped) area. This is generally consistent with the findings of the Deloitte-Touche study (1987) regarding the first SCGP, as well as the quantitative overview provided immediately preceding (Section 4.6.3). At the same time, farmers generally believe the program had little or no effect on land quality in their area, but among those who did, the number who cited a favorable effect slightly outnumbered those who indicated a negative effect.

Table 4.6.9

Proportion of Farmers Whose Management Decisions were Affected by the Special Canadian Grains Program

	Number of Responses (% of Responses to Respective Question)				
	South	Central Black	Central Gray	Peace River	All Regions[a]
Farmers receiving SCGP payment	271 (87.4)	263 (79.5)	76 (71.7)	103 (82.4)	719 (81.8)
Received payment and expected program to continue	127 (46.9)	103 (39.6)	37 (47.4)	46 (43.8)	319 (44.3)
Altered farm management due to SCGP	34 (21.7)	37 (26.8)	14 (28.6)	16 (28.6)	103 (25.4)
Did not alter management decisions due to SCGP	123 (78.3)	101 (73.2)	35 (71.4)	40 (71.4)	303 (74.6)
No response	159	196	59	70	485
Total responses	316	334	108	126	891

[a] Including responses without location coding.

Source: Questionnaire responses.

Table 4.6.10
Effect of the SCGP Program on Farmers' Own Operations in the 1980's

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	257	13 (22.0)	43 (72.9)	3 (5.1)
Summerfallow acreage	259	2 (3.5)	39 (68.4)	16 (28.1)
Forage acreage	261	5 (9.1)	46 (83.6)	4 (7.3)
Inputs per acre	256	20 (33.3)	29 (48.3)	11 (18.3)
Tillage operations	261	9 (16.4)	32 (58.2)	14 (25.5)
Livestock production	262	6 (11.1)	42 (77.8)	6 (11.1)

Region - Central Black	Number of Responses (% of Those Responding)			
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	282	12 (23.1)	38 (73.1)	2 (3.8)
Summerfallow acreage	280	7 (13.0)	30 (55.6)	17 (31.5)
Forage acreage	286	6 (12.5)	34 (70.8)	8 (16.7)
Inputs per acre	281	18 (34.0)	23 (43.4)	12 (22.6)
Tillage operations	281	9 (17.0)	31 (58.5)	13 (24.5)
Livestock production	285	14 (28.6)	31 (63.3)	4 (8.2)

Region - Central Gray	Number of Responses (% of Those Responding)			
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	89	4 (21.1)	10 (52.6)	5 (26.3)
Summerfallow acreage	90	5 (27.8)	8 (44.4)	5 (27.8)
Forage acreage	91	8 (47.1)	5 (29.4)	4 (23.5)
Inputs per acre	91	6 (35.3)	7 (41.2)	4 (23.5)
Tillage operations	90	4 (22.2)	11 (61.1)	3 (16.7)
Livestock production	92	7 (43.8)	7 (43.8)	2 (12.5)

Region - Peace River	Number of Responses (% of Those Responding)			
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	105	6 (28.6)	14 (66.7)	1 (4.8)
Summerfallow acreage	107	4 (21.1)	10 (52.6)	5 (26.3)
Forage acreage	106	6 (30.0)	8 (40.0)	6 (30.0)
Inputs per acre	105	6 (28.6)	10 (47.6)	5 (23.8)
Tillage operations	106	8 (40.0)	9 (45.0)	3 (15.0)
Livestock production	113	3 (23.1)	6 (46.2)	4 (30.8)

Province Summary	Number of Responses (% of Those Responding)			
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	733	35 (23.2)	105 (69.5)	11 (7.3)
Summerfallow acreage	736	18 (12.2)	87 (58.8)	43 (29.1)
Forage acreage	744	25 (17.9)	93 (66.4)	22 (15.7)
Inputs per acre	733	50 (33.1)	69 (45.7)	32 (21.2)
Tillage operations	738	30 (20.5)	83 (56.8)	33 (22.6)
Livestock production	752	30 (22.7)	86 (65.2)	16 (12.1)

Source: Questionnaire responses.

Table 4.6.11

Farmers' Estimates of Effects of the SCGP Program on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
- 3	9 (3.1)	10 (3.3)	3 (3.1)	2 (1.7)	24 (2.9)
- 2	8 (2.8)	11 (3.6)	6 (6.1)	2 (1.7)	27 (3.3)
- 1	11 (3.8)	17 (5.6)	3 (3.1)	5 (4.3)	36 (4.4)
No Effect	210 (72.7)	227 (74.7)	73 (74.5)	88 (75.2)	604 (74.1)
+ 1	27 (9.3)	18 (5.9)	4 (4.1)	14 (12.0)	64 (7.8)
+ 2	14 (4.8)	8 (2.6)	8 (8.2)	5 (4.3)	35 (4.3)
+ 3	10 (3.5)	13 (4.3)	1 (1.0)	1 (0.9)	25 (3.1)
Strongly Positive					
No Response	27	30	10	9	76
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.6.5 SCGP Effects

The SCGP in 1986 and 1987 (actually 1987 and 1988) both represented one-time direct income transfers to Alberta farmers. The relative size of each payment was similar.

A priori, we know that longer term management decisions are not generally based on short-term ad-hoc program initiatives. This only arises if there is a growing conviction or expectation that similar follow-up initiatives are inevitable. Then farmers respond by trying to take advantage of the anticipated payout criteria, e.g. acreage of qualifying crops.

By and large, the evidence presented in the foregoing supports this thesis. Prior research (Deloitte-Touche, 1987), the macro-data analysis herein, and the present farm survey results all suggest that the SCGP only prompted slight short-term resource management changes by a minority (perhaps 25%) of producers. Typical adjustments (by the minority) included the use of more fertilizer/herbicides per acre, a slight expansion of their cultivated (cropped) acreage, and a slight reduction in the acreage in summerfallow.

Estimates from EPIC simulations which tracked the long-term (50-year) soil quality implications of slight temporary reductions in the summerfallow acreage (about 150,000 acres across the province) suggested that we could expect only a very small long-term impact. The estimated 50-year soil saving was found to be about 0.15 percent. At the same time, if farmers' eventually expected a similar program to be implemented, say, every five years, the resulting impacts on soil quality would be magnified accordingly.

Information derived from follow-up telephone interviews with 20 randomly selected survey respondents also downplayed the potential impact of the SCGP on land use. While generally applauding the need for these "emergency" income transfers, three quarters of these producers said it had no impact on their subsequent land management decisions. Only one farmer increased his land base (on to more marginal land), whereas two farmers reduced their summerfallow acreages, and one farmer shifted to more "qualifying" crops in the following crop year.

In short, two points regarding the potential impact of the SCGP on resource use must be emphasized: (1) any identifiable impacts would have been a short-term phenomenon; and (2) any identifiable province-wide impacts would be minor; muted by both the relatively small number of farmers who actually changed land management practices because of the program as well as the intensity of that reaction. Regarding (1), cropping pattern adjustments would (like the response to LIFT in the early 1970's) probably have a small ever-diminishing impact for about 5 years. Other changes (e.g. input use) would have largely been limited to the crop years 1987/88 and 1988/89.

4.7 Canadian Crop Drought Assistance Program (CCDAP)

4.7.1 Description

With federal assistance promised to Canadian farmers during the drought period in the summer of 1988, the formal announcement of the Canadian Crop Drought Assistance Program was made on November 10, 1988. With this ad hoc program, payments for the 1988-89 crop year were to be based on yield losses specifically due to the drought; not income losses due to low prices.

The initial national cost estimate for the Crop Drought Assistance Program (CCDAP) was $850 million. As of March 26, 1990, a total of about 13,000 Alberta farmers (or about 25% of all Alberta farmers) had received about $98.1 million through the CCDAP.

Again, an initial and final payment were made. For the purposes of the initial or interim payment all Alberta townships were categorized as severe, moderate, or least affected by drought. The severe and moderate areas were those with crop losses of approximately 15% or more. Figure 4.7.1 illustrates the severe (dark shaded), moderate (partially shaded), and least affected drought areas in Alberta in 1988. It was initially estimated that about 125 townships were severely impacted by drought while about 300 townships were moderately impacted. In March 1989, producers in severe drought areas received a flat interim payment of $12/acre while those in moderate drought areas received a payment of $7/acre.

To calculate the final payment (in August 1989), the general formula employed was:

CCDAP Final Payment = Target Revenue Per Acre - [Actual Average 1988 Market Return Per Acre + Average Crop Insurance Payment Per Acre] - Interim Payment

The crops which initially qualified for this program, along with the "target" price for each crop,[14] are indicated in accompanying Table 4.7.1. Average 1988 yields and long-term yields (15 years) for each township were calculated by the Alberta Hail and Crop Insurance Corporation.

Ultimately, the list of eligible crops for the CCDAP included all grains, oilseeds, special crops, vegetables and fruit. Crops seeded prior to the drought in 1988 and cut for silage or ploughed down due to crop damage were also eligible. However, commercial forage seed and hay were once again excluded from the program for reasons of verifiability and dilution, similar to the Special Canadian Grains Program. On the other hand, in August of 1989 producers of pedigreed forage seed and alfalfa for processing were extended eligibility, while farmers who increased their summerfallow acreage in response to the drought were also included.

When the final payments were issued in the summer of 1989, deductions were also made for overpayments in Special Canadian Grains Program I or II, arrears on CWB advance crop payments, and arrears on farm improvement loans. To make further adjustments, an extensive review process was initiated by a Producer Review Committee in each province, and this was still on-going as of March 1990.

14 Target Revenue = Long-term Average Yield x Farmgate Price x .7775. Thus, mathematically, either yields or prices can be multiplied by the factor .7775 and denoted a "target". Indeed, the complexity of the payout formula itself stems from the fact that both the yield guarantee and the base price utilized by the AHCIC in 1988 were considered inadequate after the drought occurred.

Figure 4.7.1
Crop Drought Areas in Alberta, 1988

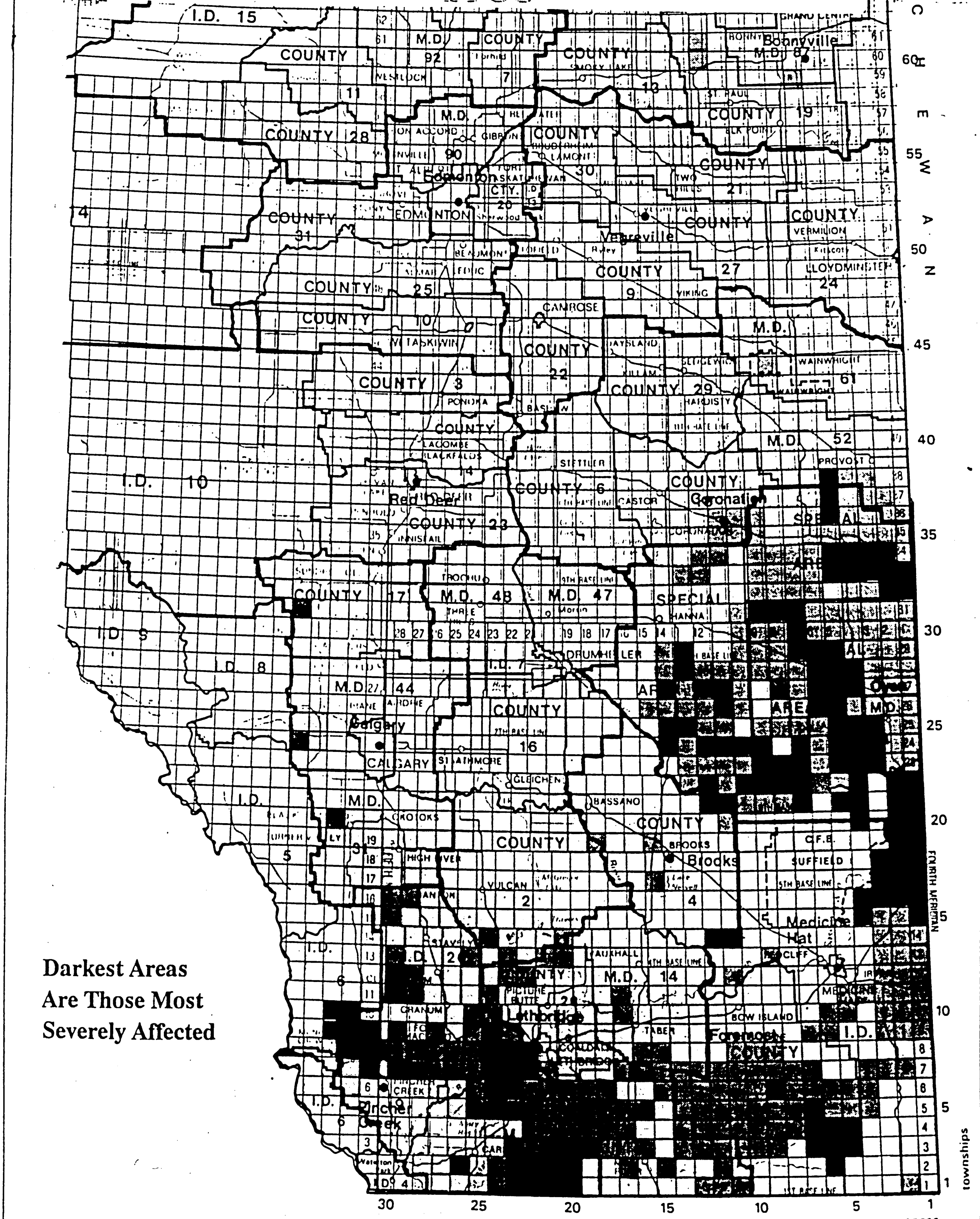


Table 4.7.1
Comparative Prices, CCDAP and AHCIC, 1988-89

	CCDAP Farm Gate Prices[a]						Alberta Hail and Crop Insurance Prices	
Crop	$/tonne		$/bu		¢/lb		$/kg	$/bu
Wheat (except durum)	160	(124.40)	4.35	(3.38)	--		0.110	2.99
Durum	170	(132.18)	4.63	(3.60)	--		0.115	3.13
Barley	105	(81.64)	2.29	(1.78)	--		0.060	1.31
Oats	140	(108.85)	2.16	(1.68)	--		0.060	0.93
Rye	110	(85.53)	2.79	(2.17)	--		0.060	1.52
Corn	135	(104.96)	3.43	(2.67)	--		0.138	3.51
Canola	290	(225.48)	6.58	(5.12)	--		0.240	5.44
Flax	320	(248.80)	8.13	(6.32)	--		0.200	5.08
Soybeans	295	(229.36)	8.03	(6.24)	--		0.248	6.75
Dry Peas	190	(147.73)	5.17	(4.02)	--		0.170	4.63
Lentils	355	(276.01)	--		0.16	(0.12)	0.300	8.16
Canary Seed	330	(256.58)	--		0.15	(0.12)	0.200	4.54
Mustard	275	(213.81)	--		0.12	(0.09)	0.225	5.10
Buckwheat	255	(198.26)	--		0.11	(0.09)	0.250	5.44
Fababeans	170	(132.18)	--		0.08	(0.06)	0.160	4.06
Triticale	110	(85.53)	2.79	(2.17)	--		0.080	1.89
Safflower	270	(209.93)	--		0.12	(0.09)	0.200	4.02
Sunflower	260	(202.15)	--		0.12	(0.09)	0.200	2.72

a Implicit prices utilized by the CCDAP = market (or farmgate) prices x 77.75 percent as indicated in brackets. (Technically, the factor 77.75% was applied to yields).

Source: Basic data from Agriculture Canada, *CCDAP News Release*, Ottawa, various, 1988-89.

4.7.2 Resource Use Issues

The ad hoc CCDAP raised a number of resource use issues, similar to those relating to the SCGP. In particular:

1. Did the exclusion of commercial forage seed and hay from CCDAP payments subsequently discourage the inclusion of hay/forage in crop rotations?
2. Did CCDAP payments for additional summerfallow in response to the drought (i.e. the acreage in excess of the producers 1983-87 average summerfallow acreage) encourage maintaining more summerfallow in subsequent years?
3. Did increasing cash flow to the farm community (which increases farmers' short-term capacity to purchase farm inputs) reduce subsequent summerfallow acreages?
4. Did increasing cash flow to the farm community encourage maintaining or even expanding annual crop production on marginal erosion-prone agricultural land?

4.7.3 Quantitative Overview

In a province-wide context, injecting $98.1 million into the agricultural economy in 1989 had a much smaller global impact than the prior SCGP injections (Table 4.7.2). That is:

Change in Crop Revenue	+ 4.7%
Change in Total Farm Cash Receipts	+ 2.2%
Change in Realized Farm Income	+15.5%

Clearly, it is not likely that a one-time change of this magnitude, even if it was equally distributed across the province, would generate any major changes in farm management practices in Alberta.

But it is crucial to point out that this cash injection was not equally distributed throughout the province; it was heavily concentrated in Census Divisions 1, 2, 3, 4, and, to a much lesser extent, 7, 10, and 12. Some very approximate regional estimates of CCDAP payment totals are indicated in accompanying Table 4.7.3. These figures, translated to a per farm basis, strongly suggest that the CCDAP probably had a very major impact on the economic well-being of some recipients. Without this assistance, net income from farm operations in C.D.'s #1 and #4 (especially #4) would probably have been negative. The CCDAP payments, covering an estimated 5.7 million acres of cropland in Alberta (about 27%) and finally averaging about $17 per acre, were a much-needed income transfer to drought-impacted farmers.

The hypothesis that this "yield supplement" somehow translated into changes in resource use are, however, extremely tenuous for at least two reasons:

1. The CCDAP was an ad hoc program specifically designed to respond to the regional drought conditions of 1988, and
2. The payout criteria made it logically impossible for a farmer to record an above-average year because of the payout.

The first point refers to the widely-held notion that it is illogical for a farmer to respond to these kinds of payments when the probability of this event (both the drought and the governments' specific response to that event) reoccurring is simply not known. Moreover, to the extent that drought-prone events do arise in these drought-prone areas, this anticipated probability of occurrence has probably already been built into the operational characteristics of the impacted farms in question.

Table 4.7.2

Role of the CCDAP in Net Farm Income, Alberta, 1988/89

Item	1986	1987	1988	1989p
Wheat	517,000	560,000	694,000	738,000
Oats	17,000	19,000	66,000	90,000
Barley	318,000	232,000	256,000	414,000
CWB Advances and Deferments (net)	24,000	-3,000	-58,000	-1,000
W.G.S.A. Payments	225,000	368,000	180,000	80,000
Special Canadian Grains Program	--	261,800	300,600	--
Canadian Crop Drought Assistance Program	--	--	--	98,100
Crop Insurance	160,000	135,000	173,000	151,000
Rye	5,000	5,000	8,000	6,000
Flaxseed	6,000	6,000	8,000	8,000
Canola	268,000	315,000	455,000	370,000
Sugar Beets*	14,000	13,000	19,000	19,000
Potatoes	31,000	35,000	40,000	40,000
Vegetables	29,000	30,000	31,000	33,000
Flori. and Nursery	24,000	29,000	34,000	37,000
Other Crops	70,000	60,000	82,000	70,000
Def. and Supp.	105,000	20,200	13,400	15,900
TOTAL CROPS	1,813,000	2,086,000	2,302,000	2,169,000
TOTAL LIVESTOCK	1,947,000	1,926,000	2,139,000	2,294,000
TOTAL FARM CASH RECEIPTS	3,760,000	4,012,000	4,441,000	4,463,000
Total Operating Expenses	2,750,000	2,729,000	2,873,000	3,078,000
Net Cash Income	1,010,000	1,283,000	1,568,000	1,385,000
Income in Kind	19,000	22,000	21,000	21,000
Depreciation Charges	670,000	666,000	667,000	676,000
REALIZED NET INCOME	359,000	639,000	922,000	730,000

p = preliminary; * Deficiency payments included in commodity receipts.
Source: Alberta Agriculture/Statistics Canada, Edmonton, December 1989.

The second point is equally compelling. Since the payout formula effectively capped crop revenues at 77.75% of long-term crop revenues,[15] it follows that incomes (or prices or yields) should still have remained below-average. This program characteristic, assuming all commodities were treated equally (to guarantee resource use neutrality) would suggest that resource-adjustments would have largely remained market-driven.

15 Technically, this factor was applied to yields. But since revenue = price x yield, this is logically equivalent to a price or revenue decrease of the same magnitude.

Table 4.7.3

Impact on Net Farm Income to CCDAP Recipients, 1988-89

Region	"Normal Per-Farm Income[a]	1988 Per-Farm Income[b]	CCDAP Payments[c] Total ($ M)	No. of Recipients	Average/ Recipient	Net 1988 Income vs "Normal"[d]
	(1)	(2)	(3)	(4)	(5)	(6)
C.D. # 1	14,000	(700)	13.1	1,351	9,696	64%
C.D. # 2	14,000	6,160	11.4	2,400	4,760	64%
C.D. # 3	14,000	35	20.3	1,620	12,508	90%
C.D. # 4	14,000	(8,295)	24.7	1,493	16,572	59%
Other	14,000	n.a.	28.6	6,136	4,662	n.a.
Alberta	14,000	n.a.	98.1	13,000	7,546	n.a.

[a] Income from farm operations. For illustrative purposes, a value of $700 M/50,000 real farmers is considered "normal". Regional estimates are not readily available.

[b] Wheat yield indices for 1988 applied to one-half of all revenue, i.e. the crops sector from farm operations less costs = 80% normal revenue. Indices = .580, .776, .601, and .363, respectively.

[c] Authors estimates. Very approximate.

[d] Columns (2) + (5) divided by Col. (1) x 100.

In part, this arises because the implicit farmgate prices utilized in the CCDAP payout calculations closely approximated actual prices received both before (1987/88) and after (1989/90) the program was in effect (Table 4.7.4).

Thus, one would expect that the CCDAP largely assisted in simply maintaining the status quo: downward pressure on the agricultural community (and an on-going shift to lower-risk operational strategies) would still be expected since effective prices generally remained below their long term average (see Col. (4), Table 4.7.4).

This expectation is generally supported by the provincial data available regarding land use in 1989 and seeding intentions in 1990 (Alberta Agriculture 1988, *Agriculture Statistics Yearbook*):

(thousand acres)

Crop	1988	1989	1990
Wheat	7,000	7,790	7,950
Oats	1,450	2,100	1,900
Barley	4,700	5,400	5,450
Rye	160	270	230
Flax	50	80	150
Canola	3,500	2,700	2,400
Summerfallow	5,350	4,950	5,000

In any event, there was an on-going trend away from higher-risk crops (e.g. canola) and towards lower risk crops (e.g. wheat). At the same time, some strengthening of market prices (esp. in 1988/89) may have helped to once again stabilize the summerfallow acreage at about 5 million acres.

Table 4.7.4
Comparative Crop Prices, 1988/89

Crop	Actual Farm Prices, 1987/88	CCDAP Implicit Farm Prices 1988/89	Actual Farm Prices, 1989/90	Long-Term Average Prices
	(1)	(2)	(3)	(4)
Wheat	3.04	3.38 (4.60)	3.57	3.91
Oats	1.39	1.68 (2.05)	1.31	1.38
Barley	1.45	1.78 (2.53)	2.07	2.20
Rye	2.13	2.17 (2.77)	2.03	2.69
Flax	5.39	6.32 (9.30)	8.20	7.29
Canola	5.83	5.12 (6.80)	5.90	6.39
Mustard (¢/lb)	.095	.09	.13	n.a.
Index (3-crop)	83.00	83.00	92.00	100.00

Sources: Cols. (1) and (3): Alberta Agriculture, March 13, 1989.
Col. (2): Table 4.7.1. Actual prices indicated in brackets.
Col. (4): Nominal prices for 1972-86, deflated by the Farm Product Price Index, March 1988 - 100.

In short, one can argue that since effective crop prices (or revenues) were at a higher level (by about 5%) in 1988/89 than would have been the case without the CCDAP, then (relative to 1988) both the market and the CCDAP should have contributed to a summerfallow decline in 1989:

Without Program: Price Index Change = 28%
With Program: Price Index Change = 33%

If summerfallow adjusts by the factor .24, then the summerfallow acreage in 1989 with and without the program would have been:[16]

Without:	4,990,000 acres
With:	4,926,000 acres
Difference:	- 64,000 acres

However, altering implied temporary (5-year) changes to crop rotations in the South accordingly, simulated EPIC erosion savings still suggest that any long-term impact on soil quality would be imperceptibly small. The projected positive impact would represent 0.04 percent of all wind and water erosion in the province over 50 years. And even if southern farmers expected a similar kind of payment, say, every five years, this figure would only climb to an estimated 0.62 percent for the province; 1.4% for the South. The simulated impact is similar to the anticipated (and equally small) consequences of the second SCGP (Section 4.6.3.3). At this level of analysis, these estimated impacts are not statistically significant.

4.7.4 Survey Results

Consistent with where the 1988 drought was concentrated (Figure 4.7.1), most survey respondents who received a CCDAP payment were located in the South and Central Black regions of the province: 62% and 24% of survey respondents respectively (Table 4.7.5). At the same time, fewer than 1 out of every 5 of these

16 Elasticity imputed from: MacGregor and Graham (1988, 61). The actual summerfallow acreage in 1989 was 4,950,000 acres (Statistics Canada).

farmers said they altered their farm management practices because of the CCDAP. And, even with respect to this small minority, it appears that the management response was relatively muted (Table 4.7.6). The most pronounced response was a subsequent effort to reduce the number of tillage operations and/or summerfallow acreage in the South.

Table 4.7.7 suggests that most farmers believe the CCDAP was an equally minor element in the decisions taken by other farmers. Over 80 percent of respondents perceived the CCDAP as having no impact on soil degradation in their communities.

Table 4.7.5

Proportion of Farmers Whose Management Decisions Were Affected by the 1988 Crop Drought (CCDAP) Program

	Number of Responses (% of Responses to Respective Question)				
	South	Central Black	Central Gray	Peace River	All Regions[a]
Farmers receiving CCDAP payment	196 (62.0)	79 (23.7)	13 (12.0)	16 (12.7)	304 (34.1)
Received payment and expected program to continue	134 (68.4)	60 (75.9)	9 (69.2)	12 (75.0)	215 (70.7)
Altered farm management due to CCDAP	26 (17.3)	11 (16.7)	0 (0.0)	5 (33.3)	42 (17.4)
Did not alter management decisions due to CCDAP	124 (82.7)	55 (83.3)	10 (100.0)	10 (66.7)	199 (82.6)
No response	166	268	98	111	650
Total responses	316	334	108	126	891

[a] Including responses without location coding.

Source: Questionnaire returns.

Table 4.7.6

Effect of the Crop Drought Program on Farmers' Own Operations in the 1980's

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	259	3 (5.3)	51 (89.5)	3 (5.3)
Summerfallow acreage	258	6 (10.3)	44 (75.9)	8 (13.8)
Forage acreage	266	4 (8.0)	44 (88.0)	2 (4.0)
Inputs per acre	260	9 (16.1)	38 (67.9)	9 (16.1)
Tillage operations	261	0 (0.0)	42 (76.4)	13 (23.6)
Livestock production	264	5 (9.6)	42 (80.8)	5 (9.6)
Region - Central Black	Number of Responses (% of Those Responding)			
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	317	3 (17.6)	12 (70.6)	2 (11.8)
Summerfallow acreage	318	2 (12.5)	10 (62.5)	4 (25.0)
Forage acreage	318	3 (18.8)	13 (81.3)	0 (0.0)
Inputs per acre	317	5 (29.4)	8 (47.1)	4 (23.5)
Tillage operations	319	3 (20.0)	8 (53.3)	4 (26.7)
Livestock production	318	6 (37.5)	9 (56.3)	1 (6.3)
Region - Central Gray	Number of Responses (% of Those Responding)			
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	106	0 (0.0)	2 (100.0)	0 (0.0)
Summerfallow acreage	106	0 (0.0)	2 (100.0)	0 (0.0)
Forage acreage	106	0 (0.0)	2 (100.0)	0 (0.0)
Inputs per acre	106	0 (0.0)	2 (100.0)	0 (0.0)
Tillage operations	106	0 (0.0)	2 (100.0	0 (100.0)
Livestock production	106	0 (0.0)	2 (100.0)	0 (0.0)
Region - Peace River	Number of Responses (% of Those Responding)			
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	118	0 (0.0)	6 (75.0)	2 (25.0)
Summerfallow acreage	119	2 (28.6)	5 (71.4)	0 (0.0)
Forage acreage	118	2 (25.0)	5 (62.5)	1 (12.5)
Inputs per acre	117	1 (11.1)	5 (55.6)	3 (2.4)
Tillage operations	117	1 (11.1)	7 (77.8)	1 (11.1)
Livestock production	121	1 (20.0)	4 (80.0)	0 (0.0)
Province Summary	Number of Responses (% of Those Responding)			
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	800	6 (7.1)	71 (84.5)	7 (8.3)
Summerfallow acreage	801	10 (12.0)	61 (73.5)	12 (14.5)
Forage acreage	808	9 (11.8)	64 (84.2)	3 (3.9)
Inputs per acre	800	15 (17.9)	53 (63.1)	16 (19.0)
Tillage operations	803	4 (4.9)	59 (72.8)	18 (22.2)
Livestock production	809	12 (16.0)	57 (76.0)	6 (8.0)

Source: Questionnaire responses.

Table 4.7.7

Farmers' Estimates of Effects of the Crop Drought Program on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
- 3	8 (2.9)	5 (1.6)	1 (1.1)	0 (0.0)	14 (1.8)
- 2	9 (3.2)	9 (3.0)	0 (0.0)	0 (0.0)	18 (2.3)
- 1	11 (3.9)	8 (2.6)	2 (2.2)	2 (1.8)	23 (2.9)
No Effect	201 (71.8)	259 (85.2)	84 (90.3)	101 (90.2)	651 (81.8)
+ 1	28 (10.0)	11 (3.6)	3 (3.2)	6 (5.4)	49 (6.2)
+ 2	11 (3.9)	4 (1.3)	1 (1.1)	2 (1.8)	18 (2.3)
+ 3	12 (4.3)	8 (2.6)	2 (2.2)	1 (0.8)	23 (2.9)
Strongly Positive					
No Response	36	30	15	14	95
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.7.5 Crop Drought Program Results

CCDAP recipients were concentrated in the south and southeast areas of the province. Payments (which were intended to supplement crop insurance payments) were made in the summer of 1989. *A priori*, one would expect these one-time payments in response to "an act of God" to have had very little effect on long-term decision making with respect to land use. And this hypothesis is generally confirmed by both our quantitative overview and information derived from the farm survey. Less than 20% of CCDAP recipients said they made any management adjustments in response to this program and the few conservation-oriented changes suggested (e.g. less tillage; less summerfallow) could really have been due to either the drought itself or the follow-up CCDAP.

Our accompanying quantitative analysis suggested that a short-term reduction in the summerfallow acreage in the South may have been the principal farm management response. But EPIC simulations which mimic this change failed to indicate any significant long-term change to soil quality because of this probable short-term adjustment.

Information derived from follow-up telephone interviews with 20 randomly selected survey respondents similarly emphasized the small short-term impact the CCDAP might have had on land use. The vast majority (19 of 20), most of whom didn't qualify for a payment in any event (about 76%), thought it had absolutely no effect on how they managed their land. Considerable animosity was also expressed regarding how the selective *ad hoc* program was actually administered.

In summary: (1) any identifiable macro-impacts would have generally been concentrated in the brown soil zone, and (2) these potential region-specific impacts would have been relatively small both because relatively few producers seemingly changed any management practices because of the CCDAP and because even if they did make some short-term adjustments, these were not extensive. In the brown soil zone, the CCDAP (or the drought itself) may have very slightly accelerated an on-going long-term trend towards less tillage and less summerfallow. Accelerated summerfallow reduction would (like the response to LIFT in the early 1970's) probably have a residual ever-diminishing impact for about 5 years. As such, the quantifiable long-term impact on soil conservation may have been very slightly positive but, using a 50-year time horizon, minute.

4.8 Land Management Programs

4.8.1 Description

Four on-going programs in Alberta have been identified as land management programs:

1. Public Land Dispositions (Alberta Forestry, Lands and Wildlife)
2. Accelerated Land Sales Program (Alberta Forestry, Lands and Wildlife)
3. Special Areas Tax Recovery Land Sales (Alberta Municipal Affairs)
4. Range and Soil Improvement Loan Program (Alberta Agricultural Development Corporation - Alberta Agriculture)

4.8.1.1 Public Land Dispositions/Accelerated Land Sales

The basic objective of the Public Land Disposition Program is to identify and dispose of public lands for agriculture and other uses in three ways:

1. An individual can apply for an agricultural type disposition on vacant public land which automatically triggers an evaluation of the land for that use and disposition;
2. Due to local demand, blocks of vacant public land are evaluated to determine their suitability for agricultural production. If found suitable, they are surveyed and made available for agricultural dispositions;
3. Land suitable for agricultural expansion is identified through Integrated Resource Plans (IRP's).

The four methods of allocating public land for agricultural dispositions are:

1. Posting the land available, receiving applications and awarding the land on the basis of need to form an economic farm unit;
2. Posting the land available for application, evaluating the applicants for eligibility and awarding the land to eligible applicants by a public draw system;
3. Advertising the land for public auction;
4. Posting the land available for bids by sealed tender.

The identification process is, in practice, largely done using traditional land classification data to establish potential agricultural productivity ratings (e.g. CLI Class 4 or better), irrespective of its location vis-a-vis the White or Green Zones.[17] Using these criteria, the overall agricultural development potential (excluding additional drainage) has been estimated to be about 13.5 M acres, almost all of it in the northern half of the province (Figure 4.8.1) according to Alberta Agriculture 1987. To date, sixteen Integrated Resource Plans have earmarked about 1.2 million acres for potential agricultural development, about 60 percent of which would come from the Green Area (Stewart, Weir and Co. 1988, 19-24).

Beginning in 1981, the Accelerated Land Sales Program was also implemented to further increase the supply of suitable public land for agricultural purposes. The goal of this program (through private consultants) was to inventory 100,000 acres of public land annually so that supply could more closely approximate latent demand (Woods Gordon/MAA 1983).

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17 White area = unrestricted agricultural development. Green area = forested non-settled public lands managed primarily for forest production, watershed protection and multiple use, including unimproved grazing.

Figure 4.8.1

Potential Crown Land Dispositions for Agricultural Development

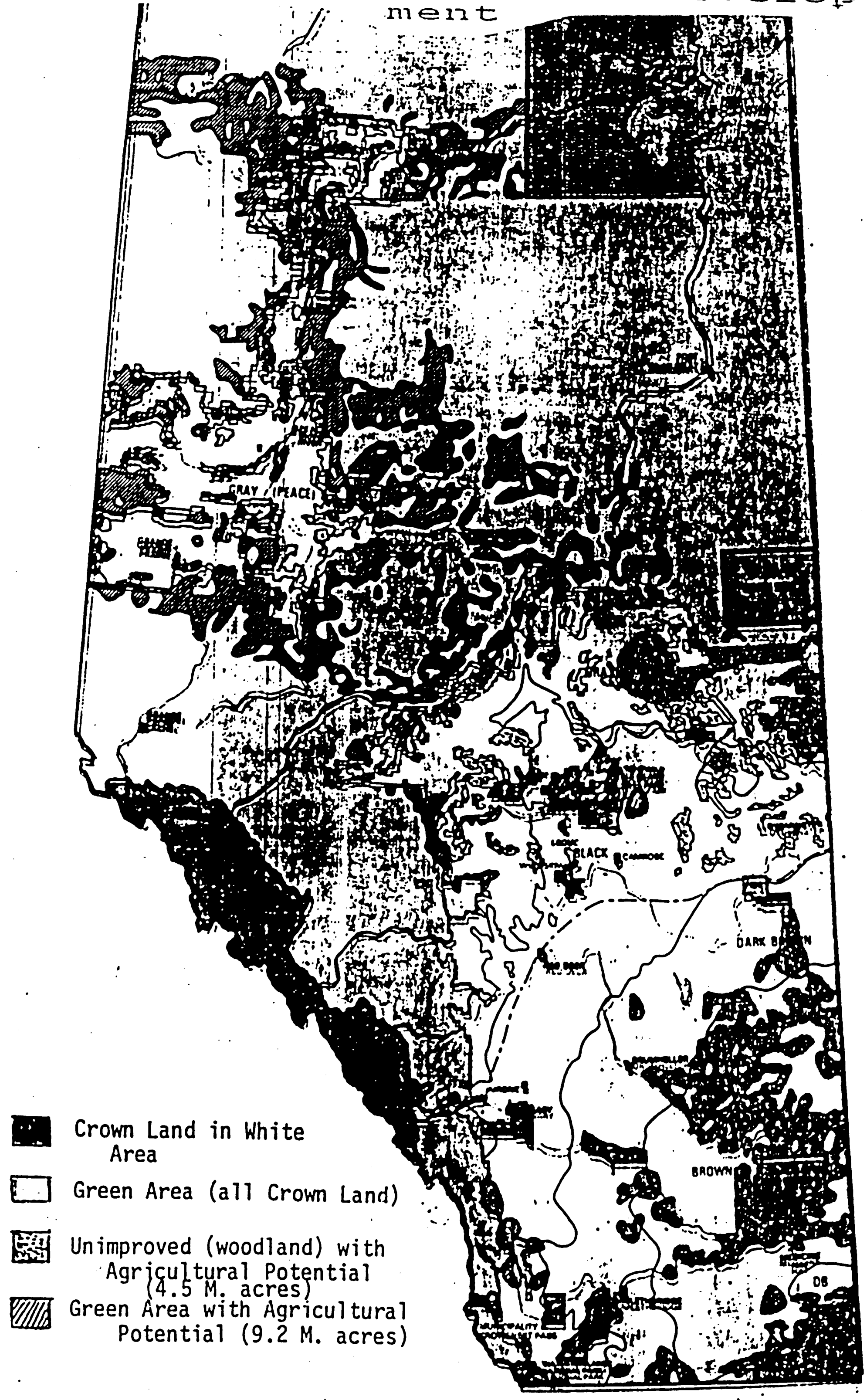
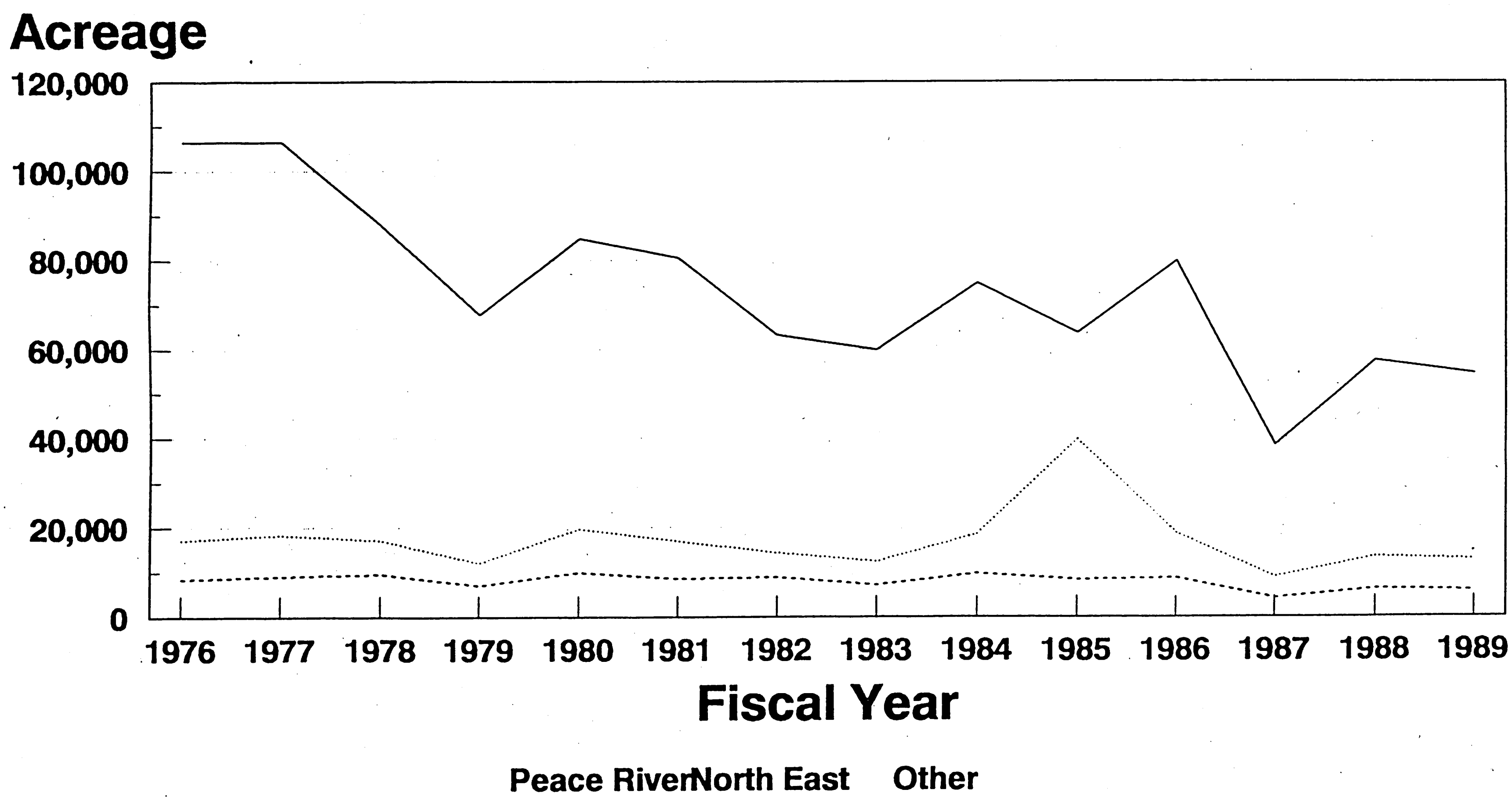


Figure 4.8.2
Acreage of Crown Land Dispositions Issued to Agriculture Leading to Title, Alberta, 1976-89



Source: Table 4.8.1

Most of this Crown Land is ultimately released after it has been posted and applicants have been very carefully screened. This rather arduous procedure makes the wholesale disposition of large tracts of Crown Land virtually impossible.

The net result of this process is illustrated in Figure 4.8.2 and accompanying Table 4.8.1. During the period 1976-86, agricultural dispositions leading to title averaged about 100,000 acres per year but since then they have fallen off.

Table 4.8.1

Acreage of Crown Land Dispositions Issued to Agriculture Leading to Title, by Region and Type of Sale, 1976-1989

	Type of Disposition[a]										
	CHS		FDS		FDL W/O[b]		Total		Region (Acres)		
Year	No.	Acres	No.	Acres	No.	Acres	No.	Acres	NW	NE	Other
1976-77	136	43,628	139	31,441	238	57,011	513	132,080	106,542	8,403	17,135
1977-78	127	39,083	152	34,211	264	60,687	343	133,981	106,527	9,088	18,366
1978-79	83	24,867	168	38,770	221	51,215	472	114,852	88,081	9,569	17,202
1979-80	77	23,566	117	29,099	148	34,158	342	86,823	67,787	7,005	12,031
1980-81	40	12,199	153	37,945	241	64,435	434	114,579	84,839	9,959	19,781
1981-82	57	18,502	138	32,667	199	54,913	394	106,082	80,617	8,551	16,914
1982-83	39	10,338	149	37,264	178	38,804	366	86,406	63,249	8,765	14,392
1983-84	47	14,108	123	29,370	154	35,874	324	79,352	59,793	7,128	12,431
1984-85	25	6,787	145	37,892	192	58,587	362	103,266	74,991	9,706	18,569
1985-86	3	1,670	141	42,106	237	67,988	381	111,764	63,649	8,326	39,789
1986-87	--	--	149	39,094	213	67,991	362	107,085	79,736	8,663	18,686
1987-88	--	--	109	24,731	89	26,929	198	51,660	38,466	4,179	9,015
1988-89	--	--	144	39,735	106	37,505	250	77,240	57,513	6,249	13,478
1989-90[c]	--	--	198	50,946	81	22,253	279	73,199	54,504	5,922	12,773

[a] Includes Civilian Homestead Sales (CHS) - discontinued in 1984, Farm Development Sales (FDS) and Farm Development Leases with Option to Purchase (FDL W/O). Regional estimates for 1986-90 calculated by the present authors.

[b] Statistics for FDL W/O to 1984-85 are estimated from the total provincial FDL statistics.

[c] For the 11-month period, April 1, 1989 to February 28, 1990.

Source: Basic data from: Land Management Branch, Alberta Forestry, Lands and Wildlife, Edmonton, March 15, 1990.

4.8.1.2 Special Areas

The Special Areas Tax Recovery Land Sales Program was initiated in 1982 in Special Areas 2, 3 and 4 (C.D. # 4) to allow long-time lease-holders to acquire a larger land base. Under this Program, the lease-holder (who must be a bonafide farmer) is eligible to apply to purchase up to $8,000 worth of the assessed value of the tax recovery land that he/she currently holds under lease.[18] The application to purchase must include at least 50% of the cultivated leased land in his/her application. The purchase price of the land is six times its assessed value.

As of December 1989, almost 600,000 acres (or say 12%) of the Crown Land (in Special Areas 2-4) had been sold in this manner (Table 4.8.2). Out of this total, about 40% represented prior leases under cultivation. Perhaps 800 farmers/ranchers (or 50% of all farmers/ranchers in the area), typically purchasing 4-5 quarters each, have already participated in this program. The present program expires on December 31, 1991.

Table 4.8.2

Special Areas Tax Recovery Land Sales Program, 1982-89

Year	Sales ('000 acres)
1982	142
1983	153
1984	117
1985	73
1986	40
1987	27
1988	22
1989	20
Cumulative Total	595,486.2[a]

[a] Errors due to rounding.

Source: Alberta Municipal Affairs, Hanna, March 19, 1990.

4.8.1.3 Range and Soil Improvement Program

Finally, the ADC Range and Soil Improvement Loan Program has encouraged more intensive agricultural land use by providing low interest loans of up to $10,000 to individual farmers for such things as brush clearing, drainage, seeding land to hay and pasture, liming, and deep plowing. Established in 1983, this program has generally been available to about 400 applicants/year while the subsidy component of the loans provided has typically amounted to about $1/2 million per year.

18 There are about 5 million acres in Special Areas 2, 3 and 4; of which about 3 million acres are tax recovery land from the 1930's which is still owned by the Crown. Most of this is improved pasture land. The Special Areas embraces about one-half of all virgin prairie in the White Area. And on Crown leases, farmers/ranchers are prohibited from breaking this up (by regulation), even to re-grass it.

4.8.2 Resource Use Issues

The central concern regarding "land clearing" programs (whether valid or not) is that Crown Lands now being sold to farmers are increasingly marginal lands from both a financial and environmental perspective. Thus, it is argued, these more erodible lands can only be profitably farmed if: (a) the land is "mined" and/or (b) disproportionately large "development" subsidies are given to the landholder by the public. This, in turn, presumably exacerbates the problem of water and wind erosion on these lands.

A related accusation is that still more land clearing on the perimeter of existing agricultural land (especially in the North) augments runoff which, in turn, generates "excessive" downstream erosion (for further details, see Section 4.9 following).

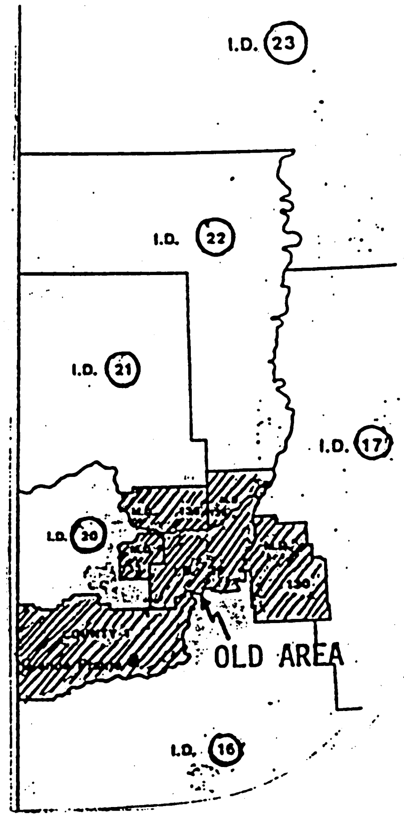
4.8.3 Quantitative Overview

The focus of this section is on Crown Land sales in NW Alberta (the Peace region) and in the Special Areas (Hanna-Oyen).

With regard to NW Alberta, it is hypothesized that if these new (more marginal) agricultural lands really are being abused, then this should be reflected in unique land use characteristics vis-a-vis neighboring lands. The most obvious evidence would be more canola and/or summerfallow in their crop rotation or, conversely, relatively less hay and improved pasture on these newer lands.

This thesis, however, is not borne out by the available secondary data as tabulated in Table 4.8.3. As a percentage of the improved land in each subregion, the respective land-use figures for more recent Crown Land sales ("new" areas) compared to contiguous older farmland are fairly similar:

	Old Area	New Area
Canola/Flax	18%	15%
Summerfallow	17%	19%
Hay/Improved Pasture	15%	22%



The canola/forage figures are, in fact, contrary to what one might expect if the land mining thesis was blatantly obvious.

Turning to the Special Areas Tax Recovery Land Sales Program, the central resource-use issue is a possible increase in the cultivation of lands which are more susceptible to wind erosion. In this case, it is hypothesized that the restrictive land use regulations on Crown Lands adequately protect against this eventuality whereas on patented (private) land no such restrictions apply.

The limited secondary data available regarding total land use in this area is generally consistent with this proposition, at least during the period 1981-86 (Table 4.8.4). The acreage changes during this period were as follows:

Total Improved (Cultivated)[19]	+ 97,500	(+ 5%)
Annual Crops and Summerfallow	+144,600	(+17%)
Hay and Improved Pasture	- 81,000	(-20%)

19 An independent estimate by Municipal Affairs suggested 81,000 acres was broken (or cultivated) during this same 1981-86 period. Personal communication.

Table 4.8.3

Land Use Patterns in New and Old Agricultural Lands in NW Alberta, 1986 (thousand acres)

Item	Old Area[a]	New Area[b]	Total Peace
Farms Reporting	3,444	4,813	8,257
Total Area	2,937.2	4,104.3	7,041.6
Total Improved	2,147.7	2,563.2	4,710.9
Crops	1,643.4	1,746.3	3,389.7
Wheat	254.0	393.5	647.5
Oats	54.8	96.2	151.0
Barley	451.9	432.4	884.3
Canola/Flax	388.7	384.1	772.8
Other Annual Crops	260.2	90.6	350.8
Tame Hay	213.9	311.5	525.4
Oats/Barley Forage	19.9	38.0	57.9
Summerfallow	359.6	495.0	854.6
Improved Pasture	110.0	263.1	373.1
Other Improved	35.0	58.5	93.5
Total Unimproved	789.4	1,541.3	2,330.7
Unimproved Pasture	510.5	786.3	1,296.8
Other Unimproved	209.8	548.8	758.6
Woodland	69.0	206.3	275.3

[a] Old Area = County #1, I.D. #19, M.D.'s 130, 133, 135, and 136.

[b] New Area = I.D.'s 16, 17, 20, 21, 22, and 23.

Source: Statistics Canada. 1987. *1986 Census of Agriculture - Alberta*, Ottawa.

This data, however, is for the entire region. Assuming identical land use shifts on previously deeded land (about 1.8 million acres) and newly deeded land (about 0.5 million acres by 1986), possible shifts due to the program itself reduce to the following:

Total Improved	+ 21,500 acres
Annual Crops/Fallow	+ 31,600 acres
Hay/Improved Pasture	- 18,000 acres

At the very least, these relatively small estimated shifts further undermine the Crown Land policy/land degradation hypotheses identified in Section 4.9.2. preceding.

Table 4.8.4

Land Use in Special Areas 2, 3 and 4; 1981 and 1986 (thousand acres)

Item	1981	1986
Farms Reporting	1588	1598
Total Area	4,804.7	4,994.1
Total Improved	1,943.5	2,041.0
Crops	963.7	1,127.0
Wheat	632.8	738.6
Oats	63.0	58.5
Barley	38.1	51.3
Canola/Flax	5.1	21.4
Other Annual Crops	44.0	61.2
Tame Hay	109.7	128.4
Oats/Barley Forage	71.0	67.6
Summerfallow	652.2	682.4
Improved Pasture	298.7	199.0
Other Improved	28.9	32.6
Total Unimproved	2,861.1	2,953.1
Unimproved Pasture		2,875.9
	2,840.5	
Other Unimproved		72.3
Woodland	20.5	4.9
Area Owned	1,717.4	1,893.5
Area Rented/Leased from Governments		2,721.6
	3,087.3	3100.6
Area Rented from Others		379.0

Source: Statistics Canada. 1982 and 1987. *Census of Agriculture - Alberta*. Ottawa.

4.8.4 Survey Responses

Province-wide, about 5.9 percent of sample respondents indicated that they had acquired Crown Land in the past decade. The purchase of Crown Land was most prevalent in the Peace River region and, to a lesser extent, the South (Table 4.8.5).

Table 4.8.5

Number of Survey Farmers Purchasing Crown Land in the Last Ten Years

Region	Number (Percentage)
South	25 (8.0)
Central-Black	3 (0.9)
Central-Gray	2 (1.9)
Peace River	22 (17.6)
All Regions[a]	52 (5.9)

[a] Including responses without location coding.
Source: Questionnaire responses.

Survey data on land use on prior Crown Land, in contrast to all land operated by survey farmers, is provided in Tables 4.8.6 and 4.8.7 respectively. Compared to total land use (Table 4.8.7), less annual crop production/fallow and more forage and improved pasture are characteristic of land recently purchased from the Crown. This is consistent with the secondary data tabulated in Section 4.8.3.

Table 4.8.6

Survey Farmers' Use of Land Purchased from Crown

	New Land Used For (acres)	Number of Responses	Average	
			Acres	(%)
Cereals/oilseeds	2850	15	91.9	30.0
Forages	1400	11	45.2	14.7
Other crops	240	3	7.7	2.5
Summerfallow	575	9	18.5	6.0
Improved pasture	2152	12	69.4	22.6
Unimproved pasture	2295	14	74.0	24.2
Total	9512	31[b]	306.8	100.0

[a] Of those responding.

[b] There were 52 farmers who indicated that they had bought crown land in the past 10 years, but only 31 of these responded giving details of how the land was used in 1989.

Source: Questionnaire responses.

Table 4.8.7

Survey Farmers' Use of All Land in 1989

	Land Used For (acres)	Number of Responses	Average (acres) a	(%)
Cereals/oilseeds	488,064	863	565.5	43.7
Hay/improved pasture	122,349	863	141.8	11.0
Other crops	96,356	863	111.7	8.6
Summerfallow	151,012	863	175.0	13.5
Unimproved pasture	211,375	863	244.9	18.9
Other	46,780	863	54.2	4.2
Total	1,115,936	863	1293.1	100.0

Source: Questionnaire responses.

Table 4.8.8

Farmers' Estimates of the Change in Quality of Crown Land They Have Purchased in Last Ten Years

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
- 3	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
- 2	1 (4.2)	0 (0.0)	0 (0.0)	1 (4.5)	2 (3.8)
- 1	2 (8.3)	0 (0.0)	0 (0.0)	2 (9.1)	4 (7.5)
No Effect	18 (75.0)	4 (80.0)	1 (50.0)	15 (68.2)	38 (71.7)
+ 1	0 (0.0)	0 (0.0)	1 (50.0)	1 (4.5)	2 (3.8)
+ 2	1 (4.2)	1 (20.0)	0 (0.0)	2 (9.1)	4 (7.5)
+ 3	2 (8.3)	0 (0.0)	0 (0.0)	1 (4.5)	3 (5.7)
Strongly Positive					
No Response	292	329	106	104	838
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

In addition, the present use of recently purchased Crown Land is rarely perceived as contributing to soil degradation, either on the farmers own newly acquired Crown Land or on his neighbors'. Almost 90 percent of all survey farmers with newly acquired Crown Land believe their ownership of this land has had either no effect or a positive effect on its quality (Table 4.8.8). And even with regard to prior Crown Lands now owned by neighboring farmers, over 80 percent of the responses are still either neutral or positive (Table 4.8.9).

Table 4.8.9

Farmers' Estimates of Effects of Crown Land Sales on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
-3	12 (4.8)	12 (4.5)	4 (4.3)	7 (6.3)	35 (4.8)
-2	16 (6.5)	13 (4.8)	3 (3.3)	12 (10.7)	44 (6.0)
-1	10 (4.0)	8 (3.0)	4 (4.3)	12 (10.7)	35 (4.8)
No Effect	189 (76.2)	223 (82.9)	75 (81.5)	66 (58.9)	559 (76.8)
+1	8 (3.2)	7 (2.6)	2 (2.2)	7 (6.3)	24 (3.3)
+2	6 (2.4)	3 (1.1)	2 (2.2)	6 (5.4)	17 (2.3)
+3	7 (2.8)	3 (1.1)	2 (2.2)	2 (1.8)	14 (1.9)
Strongly Positive					
No Response	68	65	16	14	163
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.8.5 Crown Land Disposition Results

The survey and secondary data on prevailing land use on prior Crown Lands versus neighboring lands all indicates that prior Crown Lands tend to be utilized in a less intensive manner, more pasture/forage and less annual crop production/fallow. If recent Crown Land is typically more "marginal" agricultural land, this is totally consistent with our *a priori* expectation.

Utilizing a 50 year time horizon, the projected additional erosion attributable to continued Crown Land sales of about 100,000 acres per year would augment all on-going wind and water erosion in the province by about 5.8 percent. Regionally, the percentages are 2.0%, 3.6%, and 26.5% in the South, Central Gray, and Peace River regions respectively. These impacts are relatively severe vis-a-vis other programs considered herein. This does not in any way imply, however, that any major macro-productivity (yield) or net economic costs will be incurred. These changes are still expected to be minor.

Finally, the only direct evidence we have as to the changing quality of prior Crown Land is the farmers' own perception that nearly 90 percent of all farmers operating this land believe it is now as good (or better) than when it was initially purchased from the Crown (Table 4.8.8). Conversely, over 10 percent feel it has deteriorated--particularly in the South and Peace River regions. And, their assessment of the changing condition of neighboring prior Crown Lands is generally similar, although in this case nearly 30 percent of Peace River area respondents feel these lands have deteriorated since becoming private.

This is not to say, however, that there are no soil quality impacts vis-a-vis remaining Crown Land (most of which is either virgin land or unimproved pasture land). Almost by definition the rate of erosion on agricultural land will exceed that of native land. EPIC simulations put these projected impacts into context, as tabulated in accompanying Table 4.8.10.

Table 4.8.10

Simulated Soil Loss Estimates Associated with Crown Land Sales

	Crown Land Sales (000 acres)		EPIC Erosion Losses (50 years)		Total Loss
Region	Annual	50 Year Average Total	Agri.[a] (mm.)	Virgin (mm.)	(m. tonnes)
South	30	750	10.2	1.3	27.0
Central (B)	--	--	11.1	1.1	--
Central (G)	5	125	24.4	2.1	11.3
Peace	65	1,625			181.2
Province	100	2,500			181.2

[a] Based on the least erosion-prone simulation conducted; WCBB, WCBB, WBFF, and CBFF from south to north respectively.

Follow-up telephone interviews with twenty randomly selected survey respondents generally endorsed the retention of Crown Lands by government to insure maintenance of this resource base for multiple non-intensive use, e.g. unimproved pasture leases. Thus, despite the fact that farmers' seem fairly confident that existing farmer use of prior Crown Land has generally not had a negative qualitative impact on their lands, it appears equally true that more intensive use of any prior or existing Crown Lands also lacks widespread support in the agricultural community.

4.9 Water Management Programs

4.9.1 Description

Alberta Environment is responsible for all off-farm water management and overall basin planning, while Alberta Agriculture provides services and programs for on-farm water management. Three programs are of particular concern to this study: (1) Alberta Water Management and Erosion Control Program - AWMECP; (2) Soil Conservation Area Program - SCAP; and (3) Farm Development and Reclamation Program - FDRP.

1. Alberta Water Management and Erosion Control Program

The objective of the Alberta Water Management and Erosion Control Program (AWMECP) is to provide assistance to local authorities for the enhancement of water resources and to provide corrective measures where water, in its natural state, creates conditions adverse to the public interest. The program provides grants on a 75:25% cost sharing basis for water management projects and grants on an 86:14% basis for flood control, drainage and erosion control projects on agricultural lands. For projects in the Northern Alberta Erosion Control Area, 100% of engineering costs are covered by the program and maintenance costs may be partially covered.

Any local authority with a water problem may approach the Department of Environment for assistance. The Department then does an inspection to determine if the project is eligible. Projects for flood control, erosion control, drainage, and "fish, waterfowl and wildlife enhancement" are eligible for funding under the program. Projects are expected to be in the public interest, promote sound resource management and have a demonstrated need. Projects also must be technically, environmentally and economically feasible. Some drainage has occurred under AWMECP as part of agricultural water management projects. At the same time, Alberta Environment has on occasion used the financial leverage of the program to ensure the preservation of wetlands in spite of the desires of landowners and municipalities.

2. Soil Conservation Area Program (SCAP)

In 1972, the Soil Conservation Area Program (SCAP) was established by Alberta Agriculture. This program provides cost-sharing grants of up to 60 percent to Agricultural Service Boards undertaking programs related to soil erosion and salinity. Although this program was not intended to do so, some funding of drainage occurred. To correct this, the SCAP guidelines were changed in the early 1980s to specifically state that SCAP funding was for reclamation of water-caused erosion and not for drainage. This created a gap in funding. Large water management projects were eligible for AEMECP cost sharing but smaller on-farm water management projects had no similar program.

3. Farm Development and Reclamation Program (FDRP)

In recognition of the need for a program other than SCAP to deal with on-farm water issues the Farm Development and Reclamation Program (FDRP) was created in 1985. Similar to SCAP, this program provides cost-sharing grants (maximum of 60 percent) to Agricultural Service Boards undertaking programs that relate to:

a. Water/Slough Consolidation: Projects that consolidate nuisance waterbodies on-farm into storage ponds or reservoirs to improve field operations, increase productive land area, and/or provide water for livestock, domestic, supplemental irrigation or other purposes.

b. On-farm Drainage and Channel Improvements: Projects that drain nuisance waterbodies and/or wetlands such as peat bogs and sedge bogs so that land is reclaimed for production, or to improve or clean on-farm waterways and channels to reclaim waterlogged or flooded areas.

The FDRP program was designed to help landowners alleviate problems created by insufficient or excess on-farm water. Most of the work since the inception of the FDRP was straight-forward drainage. This has occurred in spite of efforts to promote greater end use of the water on-farm through the use of educational techniques such as brochures, posters and film presentations.

Farm requests for FDRP grants have been numerous. In its first year of operation, there were over 300 applications and there were over 750 applications during 1985-89. About 40-45 percent of all applications came from the Peace Region. Grant allocations under FDRP usually total about $100,000/year. The FDRP guidelines were changed April 1, 1989 to eliminate funding of uncontrolled drainage projects. The new guidelines stress that FDRP projects should demonstrate the proper use of limited water supplies for domestic, livestock and crop production purposes. The objective now is to fund one demonstration project each year in each municipality in the province.

4.9.2 Resource Use Issues

Wetlands generate numerous environmental, economic and social benefits including some agricultural values, ecological values, heritage values, peat resource values, recreation and tourism values, hydrological values, wildlife and fisheries habitat values, and others. Still, wetlands continue to be lost for a variety of reasons, particularly drainage to facilitate agricultural crop production, climatic fluctuations, and urban, industrial and transportation development. The Canadian Wildlife Service presently estimates that 0.5% of Alberta's wetlands are lost each year because of agricultural drainage. This alone (based on Table 4.9.1) represents up to 60,000 acres of wetlands per year. In turn, runoff (and hence soil erosion) is augmented.

Eventually, all non-permanent water bodies could be endangered (some 3.8 M. acres), in addition to the further loss of 2.7 million acres of bog/fen.[20] Farmers on patented (private) land can legally engage in on-farm drainage totally unimpeded by societal (government) concerns so long as run-off patterns remain unaffected on neighboring land. Although drainage projects which encompass an area larger than a single land parcel technically require licensing by Alberta Environment, projects confined to a single quarter-section do not. Unofficially, it is estimated that 75% of on-farm drainage is not licensed.

In short, agricultural drainage, particularly of non-permanent wetlands, is often financially attractive to farmers because they are not liable for the off-farm costs of flooding, erosion control, the mitigation of wildlife habitat losses, and other lost societal values.[21] In this context, less (not more) drainage is socially desired. Yet, at least historically, society, through government program and policy direction, and via direct and indirect subsidies, has sometimes actively encouraged the drainage of wetlands. Potential benefits, such as increased food production, community development and expansion of the agricultural land base, were felt to outweigh the possible negative consequences of wetland loss and soil degradation. Local governments may have also seen wetland drainage as a means for maintenance and enhancement of the property tax base (see Section 4.10 following) or as a vehicle for economic development.

4.9.3 Quantitative Overview

To help put on-going water management programs into context, reference to historic expenditure patterns for the AWMECP (by far the largest of the three programs here considered) is particularly instructive (Table 4.9.2).

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20 The *Agricultural Land Base Study* only considers non-permanent water bodies in Northern Alberta as having agricultural potential. But non-permanent water bodies in Southern Alberta are equally susceptible; perhaps more so.

21 These costs are often relatively high. A study in NW Alberta estimated that off-farm drainage infrastructure costs alone cost about $222 per acre - approximately equal to the agricultural value of the land itself. See: Alberta Environment, *Sub-Basin Water Management Planning Study in NW Alberta - Summary Report - The Study to Date*, Edmonton, 1988.

Table 4.9.1

Estimated Acreage of Wetlands in the Agricultural Regions of Alberta, (by Wetland Type and River Basin, 1987)

River Basin	Basin Area 1	Non-Permanent Slough/ Marsh	Sheet-water	Seep	Total Non-Permanent	Permanent Slough/ Marsh	Lake/ Pond	Bog/Fen	Water-course	Total Permanent	Total	% of Basin Occupied by Wetland
					- (thousands of acres) -							
Peace	11,244	75	206	0	281	14	71	3,062	389	3,536	3,817	33.94%
Athabasca	5,391	52	110	0	162	84	208	1,460	82	1,834	1,997	37.04%
Beaver	2,327	37	0	0	37	50	258	406	59	772	809	34.78%
North Saskatchewan	8,663	803	0	0	803	91	114	563	246	1,015	1,818	20.98%
Battle	8,317	830	0	6	836	29	57	0	87	174	1,010	12.14%
Sub-Total	35,942	1,797	316	6	2,119	269	707	5,490	864	7,331	9,450	
Red Deer	10,760	798	0	31	829	26	38	86	314	465	1,293	12.02%
Bow	4,124	223	0	25	248	0	16	0	30	46	294	7.13%
South Saskatchewan	4,516	376	0	55	431	3	42	0	162	207	637	14.11%
Oldman	5,391	73	0	10	83	1	12	0	180	193	276	5.12%
Milk	1,544	66	0	8	74	2	1	0	39	42	116	7.51%
Total	62,277	3,333	316	135	3,784	301	816	5,576	1,589	8,282	12,066	19.38%

[a] White Zone or agricultural area only, does not include "Green Zone".

Source: Alberta Water Resources Commission, *Drainage Potential in Alberta: An Integrated Study - Summary Report*, Edmonton, 1987.

Table 4.9.2

Alberta Water Management and Erosion Control Program; Expenditure Patterns Profile 1981/82 - 1989/90
($ '000)

Item	No. of Projects	Expenditure	%
Fiscal Year			
1981/82	43	$5,355.6	
1982/83	54	5,449.0	
1983/84	60	3,203.9	
1984/85	65	5,036.2	
1988/86	93	6,143.2	
1986/87	77	6,341.9	
1987/88	80	5,389.9	
1988/89	65	4,568.7	
1989/90	79	5,091.7	
Region (9 years)			
Peace River	130	12,195.9	(26.6)
Edmonton	274	19,463.9	(42.5)
Red Deer	90	4,173.4	(9.1)
Calgary	59	5,056.8	(11.0)
Lethbridge	63	4,935.7	(10.8)
			(100.0)
Type of Project (9 years)			
Rural	437	25,910.6	(56.5)
Drainage	185	9,517.8	(20.8)
Erosion/Flood Control	224	14,663.9	(32.0)
Other	28	1,728.9	(3.7)
Urban	179	19,915.1	(43.5)
			(100.0)

Source: Basic data from Water Resources Management Services, Alberta Environment, Edmonton, July 1990.

Table 4.9.2 underlines three points:

- Total annual expenditures have remained relatively constant during the entire 1981-89 period; about $5M/year.
- Expenditures have typically been very heavily concentrated in the relatively water-abundant Edmonton-Peace River regions; almost 70% of total expenditures per annum.
- Only a little over one-half (i.e. 57%) of all expenditures have been allocated to rural projects while about one-fifth (i.e. 20.8%) of all expenditures during 1981-89 have been designated rural "drainage" projects. Considerably more (i.e. almost $15M) has been spent on rural erosion and flood control while still more (i.e. almost $20M) has been spent on urban projects.

This therefore, clearly suggests that the amount of government-supported "drainage" has been very limited. For example, if, for illustrative purposes, we assume total agricultural drainage costs average $500/acre, the acreage drained with government support might have recently amounted to some

$$\frac{\$9,518,800}{(86\%)(\$500)(9years)} = 2,500 acres/year$$

According to the CWS (see Section 4.9.2 above), this would represent less than 5% of all on-going agricultural drainage in the province. In this context, one might expect equally muted long-term impacts on province-wide soil quality, even if a worst-case scenario was simulated. The EPIC-generated results in accompanying Table 4.9.3 are illustrative. Even if these very limited initiatives induced more agricultural cultivation at the rate of 3,000 acres per year for 50 years, the expected net negative effect might still only contribute 0.20 percent to all on-going wind and water erosion in the province and the regions here considered.

Table 4.9.3

Simulated Soil Loss Estimates Associated with Agricultural Drainage Programs

	Subsidized Drainage[a] (000 acres)		EPIC Erosion Losses (50 years)		Total Loss
Region	Annual	50 Year Average Total	Agri.[b] (mm.)	Virgin (mm.)	(m. tonnes)
South	0.3	7.5	10.2	1.3	0.3
Central (B)	0.6	15.0	11.1	1.1	0.6
Central (G)	1.3	32.5	24.4	2.1	2.9
Peace	0.8	20.0			1.8
Province	3.0	75.0			5.6

[a] Exclusively for dry land agriculture.

[b] Based on the least erosion-prone simulation conducted; WCBB, WCBB, WBFF, and CBFF from south to north respectively.

Moreover, even these relatively few rural "drainage" projects may not have had a deleterious effect on soil quality. These projects may have actually reduced potential water erosion because all licensed projects are properly designed and constructed. This allows for some degree of control over farm management practices.

Thus, our *a priori* expectation would be that the net effect of government-sponsored water management programs on the agricultural land base could be either slightly positive or slightly negative but, in a macro-context, it is undoubtedly very, very small. This refers only to subsidized drainage or dryland. Moreover, no major changes in productivity or economic costs/benefits are implied.

4.9.4 Survey Responses

Fifteen percent of survey respondents indicated a past involvement with a drainage or other water management project (Table 4.9.4). The reported effects, shown in Table 4.9.5, involve net increases in all cited categories: crop area, hay/forage area, livestock and domestic water supplies, crop yields and field efficiency. Waterfowl damage is also reported to have increased in a few instances (18 respondents), but conversely a few farmers (12) reported decreases in waterfowl damage. Tables 4.9.6 and 4.9.7 compare farmer reactions to drainage programs versus other water development programs. While the responses differ somewhat in view of the different nature of the programs, both types of programs are seen by the vast majority of respondents as having positive or neutral effects on soil quality in their communities.

Tables 4.9.8 indicates the perception that these programs have led to either little change or a slight net improvement in land quality in the communities in which the respondents live.

Table 4.9.4

Number and Proportion of Survey Farmers Reporting Involvement With Water Management Programs

	Number of Responses (% of Responses to Respective Question)				
	South	Central Black	Central Gray	Peace River	All Regions[a]
Participated in water management project	48 (15.5)	38 (11.4)	22 (21.0)	24 (19.4)	134 (15.3)
Participated in drainage project	2	11	8	9	30
Did not participate in water project	262 (84.5)	294 (88.6)	83 (79.0)	100 (80.6)	744 (84.7)
No response	6	2	3	2	13
Total responses	316	334	108	126	891

[a] Including responses without location coding.
Source: Questionnaire responses.

Table 4.9.5
Effects of Water Management Programs on Farmers' Own Operations

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Annual crop area	279	8 (21.6)	29 (78.4)	0 (0.0)
Hay/forage area	279	10 (27.0)	25 (67.6)	2 (5.4)
Livestock water	269	40 (85.1)	6 (12.8)	1 (2.1)
Domestic water	277	21 (53.8)	17 (43.6)	1 (2.6)
Crop yields	280	13 (36.1)	23 (63.9)	0 (0.0)
Waterfowl damage	282	7 (20.6)	26 (76.5)	1 (2.9)
Efficiency in field	281	16 (45.7)	18 (51.4)	1 (2.9)
Region - Central Black				
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Annual crop area	303	10 (32.3)	20 (64.5)	1 (3.2)
Hay/forage area	301	10 (30.3)	21 (63.6)	2 (6.1)
Livestock water	301	18 (54.5)	14 (42.4)	1 (3.0)
Domestic water	303	9 (29.0)	21 (67.7)	1 (3.2)
Crop yields	303	10 (32.3)	19 (61.3)	2 (6.5)
Waterfowl damage	305	5 (17.2)	22 (75.9)	2 (6.9)
Efficiency in field	304	14 (46.7)	16 (53.3)	0 (0.0)
Region - Central Gray				
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Annual crop area	91	8 (47.1)	8 (47.1)	1 (5.9)
Hay/forage area	92	11 (68.8)	5 (31.3)	0 (0.0)
Livestock water	92	8 (50.0)	8 (50.0)	0 (0.0)
Domestic water	92	3 (18.8)	13 (81.3)	0 (0.0)
Crop yields	91	8 (47.1)	9 (52.9)	0 (0.0)
Waterfowl damage	91	4 (23.5)	9 (52.9)	4 (23.5)
Efficiency in field	91	13 (76.5)	4 (23.5)	0 (0.0)
Region - Peace River				
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Annual crop area	109	7 (41.2)	9 (52.9)	1 (5.9)
Hay/forage area	109	6 (35.3)	10 (58.8)	1 (5.9)
Livestock water	112	3 (21.4)	11 (78.6)	0 (0.0)
Domestic water	110	4 (25.0)	12 (75.0)	0 (0.0)
Crop yields	108	11 (61.1)	5 (27.8)	2 (11.1)
Waterfowl damage	110	2 (12.5)	9 (56.3)	5 (31.3)
Efficiency in field	106	14 (70.0)	4 (20.0)	2 (10.0)
Province Summary				
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Annual crop area	788	33 (32.0)	67 (65.0)	3 (2.9)
Hay/forage area	787	37 (35.6)	62 (59.6)	5 (4.8)
Livestock water	779	70 (62.5)	40 (35.7)	2 (1.8)
Domestic water	788	37 (35.9)	64 (62.1)	2 (1.9)
Crop yields	788	42 (40.8)	57 (55.3)	4 (3.9)
Waterfowl damage	794	18 (18.6)	67 (69.1)	12 (12.4)
Efficiency in field	788	57 (55.3)	43 (41.7)	3 (2.9)

Source: Questionnaire responses.

Table 4.9.6

Comparison of Farmers' Response to Drainage Programs with Other Water Management Programs
(% of Responses)

Effect on:	Drainage Programs			Other Water Programs		
	Increase	No Change	Decrease	Increase	No Change	Decrease
Annual crop area	76.9	23.1	0.0	14.3	82.5	3.2
Hay/forage area	66.7	33.3	0.0	24.6	69.2	6.2
Water for livestock	21.7	78.3	0.0	75.0	22.4	2.6
Domestic water	12.5	83.3	4.2	43.9	54.5	1.5
Crop yields	74.1	22.2	3.7	29.7	67.2	3.1
Waterfowl crop damage	20.0	44.0	36.0	19.7	75.4	4.9
Field operation efficiency	88.9	3.7	7.4	43.8	54.7	1.6

Source: Questionnaire responses.

Table 4.9.7

Comparison of Farmers' Response to Drainage Programs with Other Water Management Programs
(% of Responses)

Effect on:	Drainage Programs			Other Water Programs		
	More	No Change	Less	More	No Change	Less
Water erosion (own land)	11.1	55.6	33.3	2.4	78.8	18.8
Wind erosion (own land)	13.0	78.3	8.7	1.3	89.9	8.9

Effect on:	Drainage Programs			Other Water Programs		
	Negative	No Effects	Positive	Negative	No Effects	Positive
Quality of soil in your area	10.0	26.7	63.3	6.0	48.2	45.8

Source: Questionnaire responses.

Table 4.9.8
Farmers' Response as the General Effects of Water Management Programs on the Quality of Neighboring Agricultural Land

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
-3	5 (2.0)	12 (4.1)	3 (3.4)	7 (6.3)	24 (3.2)
-2	2 (0.8)	12 (4.1)	9 (10.1)	12 (10.7)	26 (3.5)
-1	3 (1.2)	10 (3.4)	3 (3.4)	12 (10.7)	23 (3.1)
No Effect	157 (61.3)	170 (58.6)	48 (53.9)	66 (58.9)	417 (55.5)
+1	42 (16.4)	42 (12.6)	9 (10.1)	7 (6.3)	124 (16.5)
+2	29 (11.3)	25 (8.6)	10 (11.2)	6 (5.4)	81 (10.8)
+3	18 (7.0)	19 (6.6)	7 (7.9)	2 (1.8)	56 (7.5)
Strongly Positive					
No Response	60	44	19	14	140
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.9.5 Water Management Program Results

The principal objective of most water management projects (exclusive of large-scale irrigation) is to control flooding and soil erosion and/or improve domestic, municipal or livestock water supplies. Only a small percentage of total program expenditures (say 20%) is allocated to agricultural land "drainage". Our province-wide EPIC simulations of a worst-case scenario indicate that it is highly unlikely that negative impacts on long-term soil quality have been underestimated. All things considered, the net effect may even be slightly positive.

Nearly all survey respondents report some advantages to various water management programs (Table 4.9.4) while program effects are generally perceived to have had either a positive or neutral effect on the quality of agricultural land in their area (Table 4.9.7). This net positive perception is statistically significant, as calculated in Appendix D.

Subsequent telephone interviews with twenty randomly selected survey respondents illicited an equally positive response. On-going PFRA/Alberta Environment subsidies for water well and dugouts were most frequently cited as being particularly beneficial to the farm community.

Program diversity and the multiple objectives of various relatively small water-related programs, however, virtually prohibits the use of other more rigorous analytical techniques to establish the relative magnitude of this apparently positive net macro-effect on soil conservation. In turn, the relatively small monetary value of this net impact on agricultural productivity in Alberta (vis-a-vis other programs considered herein) remains equally obscure.

4.10 Municipal Farm Land Assessment Procedures

4.10.1 Introduction and Background

Most of the farm land in Alberta is located within the administrative boundaries of 75 rural municipalities (31 counties, 22 municipal districts, 19 improvement districts and 3 special areas). Standards and methods for assessment of farm land for property tax purposes are contained in the 1984 Municipal Assessment Manual (Alberta Municipal Affairs, 1984). While only about one-fifth of the rural municipalities currently have farm land assessments prepared according to the 1984 procedures, all new general assessments are being prepared using the 1984 rating system. The new rating system should be incorporated into general assessments in a majority of the rural municipalities by 1995 with most completed by 1999 (Ball, 1990 and Waters, 1990). Municipalities in Alberta are currently required by statute to complete a general assessment every seven years. Extensions to this statutory requirement can be applied for.

Prior to the development of the current system, assessments were based on a system of rating or ranking soils using a modified "Storie system". The "Storie soil index system" was developed in 1933 to rate the agricultural value of soils in California. This system was adapted for farm land assessments in Alberta, and was modified regularly for over 25 years. A change in the assessment rating system was made in 1984. Revisions to the procedures and the Assessment Manual were also made. Updates to the Manual were issued in May, 1990 and additional updates to include recent amendments to the Municipal Taxation Act (Speaker, 1990) to incorporate irrigated land ratings are to be issued soon.

While a major change was made in 1984, the primary soil characteristics used before and after 1984 are similar, using soil quality as the primary factor for assessment purposes. Ratings of soils for taxation purposes attempt to reflect differences due to soil degradation; however, the current 1984 assessment procedures are believed to be a more accurate reflection of the effect of soil degradation on the productive capability of farm land.

4.10.2 A Summary of the Assessment Procedures Used in Alberta

The value of agricultural land for assessment purposes is based on its productive value. Assessors use guidelines in the form of Assessment Manuals where the procedures used measure the potential of farm land to produce income from farming operations. The current rating system is based upon the concept of average net income. The system used prior to 1984 was based on total gross income. The differences between these two concepts is illustrated as follows:

<u>Gross Income Concept</u>	<u>Net Income Concept</u>
Gross Income (Land with No Limitations) = $100.00/acre	Gross Income (Land with No Limitations) = $100.00/acre
	Total Expenses (Land with No Limitations) = $70.00/acre
	Net Income (Land with No Limitations) = $30.00/acre

... continued

Limitation X Reduces Total Yield by 20% and Increases Expenses by $3.00/acre

Gross Income (Land with Limitation X) = $80.00/acre	Gross Income (Land with Limitation X) = $80.00/acre
	Total Expenses (Land with Limitation X) = $73.00/acre
	Net Income (Land with Limitation X) = $7.00/acre
Rating Factor for Limitation X = 80.00/100.00 = 0.80	Rating Factor for Limitation X = 7.00/30.00 = 0.23

The above illustration shows how the current system provides larger decreases in assessments due to various limiting factors (soil quality being one of the most significant). Major soil degradation (e.g., erosion and salinity) is reflected in lower assessments and lower taxes paid by the farmer to the municipality.

The current assessment rating system ranks a parcel of land in comparison with a predetermined area in the province that consistently produces the highest net income, over the long term, under typical management practices. The system incorporates the effect of soil quality, climate, physical features, and location.

The assessment formula used is as follows:

Assessment = FAV x P

where,

FAV= Fair Actual Value

P= Percentage of Fair Actual Value factor, prescribed by regulation - currently 65% or 0.65

FAV= AUVBR x BYM x FR x A x L

where,

AUVBR= the Agricultural Use Value Base Rate, per acre, prescribed by regulation - currently as follows using 1983 as the Base Year:

Dryland Arable= $435.00 per acre

Dryland Pasture= $250.00 per acre

Irrigated = $645.00 per acre

BYM= the Base Year Modifier, prescribed by regulation, for the base year of the general assessment - this value has ranged between 0.75 and 1.0 since 1983 for dryland arable and irrigated land and between 0.95 and 1:25 for pasture land.

FR= the Final Rating determined in accordance with the rating system in the 1984 Assessment Manual. The basis for the final rating is summarized subsequently in this paper.

A= number of Acres in the field or all the fields in a parcel.

L= net Location factor which rates the proximity of the land to an urban centre to account for its location advantage on the basis of marketing, shopping, cultural, recreation and school facilities. This factor ranges between 1.0 and 1.4 and is assigned based on distance from and the class/size of the urban centre. Adjustments are made based on access and proximity to various classes of roads. The Final Rating (FR) for a field or parcel of land is obtained by calculating a Net Productivity Rating (NPR) and then subtracting a calculated Increased Cost of Production Rating (ICPR) from the NPR.

For assessment purposes, all land is classified into one of three classes:

Arable

Non Arable (Pasture)

No Agricultural Economic Value

4.10.3 Arable Land

The factors that are considered in the rating system for arable land fall into two major rating components:

Net Productivity Rating involves the comparison of a parcel of land to an area in the province where the soil produces the highest average net income consistently over an extended period of time. This area is located in the southern portion of Agroclimatic Area 1 on soil of the Antler Soil Series (black soil zone north of Calgary). This soil type receives the highest rating (100). All other areas receive a rating less than 100 in comparison to this soil type and area producing the highest average net income.

Rating factors include erosion, on the basis of potential yield reduction.

Increased Cost of Production Rating involves the evaluation of adverse conditions that may result in production costs which exceed the established optimum production costs that are reflected in the Net Productivity Rating. Adjustments are made to reflect the effect on net income of the adverse conditions.

4.10.3.1 Non-Arable Pasture Land

The rating system for non-arable land involves assessment rating on native pasture, improved pasture and native hayland. The system is based on a rating of the land parcel's ability to provide net income through the production of forage expressed in terms of the ability to graze livestock (i.e., livestock carrying capacity). Pre-calculated final ratings are provided for each agricultural region for native pasture, improved pasture and native hayland. These ratings include the effect of soil quality, climate, landscape features and location.

Pasture ratings and assessments are significantly lower than the arable ratings on the same land and are applied where farmers convert marginal land to permanent grass cover or when grassed waterways are used.

4.10.3.2 No Agricultural Economic Value

This designation is used when land makes no contribution to net income, through being nonproductive or totally isolated. Small areas in arable land may be identified as not producing enough gross income to meet the cost of production (e.g., severely eroded knolls).

A comparison of typical farm land assessments and taxes paid is presented in Table 4.10.1. While these data are typical of assessments and taxes on a per acre basis, the variability within a parcel of land and between parcels is very large and average situations seldom exist. No parcel of land is homogeneous; therefore, the final rating for a parcel is a composite of all the land units rated on an individual parcel.

The data in Table 4.10.1 show that the taxes paid on farm land range between $0.87 per acre and $5.84 per acre for the calculated examples. This is likely a reasonable representation of actual assessments and taxes paid. Fenton (1990) indicates that current taxes paid on farm land range from about $0.50 per acre to slightly over $5.00 per acre. Taxes paid on poor quality, non-arable pasture land would be at the bottom of the range (or even lower).

4.10.4 The Effect of Soil Degradation on Municipal Farm Land Assessments and Taxes Paid

There are no studies, analyses or summaries available that examine the variability of assessments or taxes paid on farm land based on soil quality (including impacts of soil degradation). Only gross assessment values and taxes for all farm land by municipality are available. An estimated breakdown of assessments by arable land, pasture and irrigated land in each municipality is provided by Waters (1990).

Table 4.10.1

Comparison of Typical Farm Land Assessments and Taxes Paid

Farm Land Description	Final Assessment		Annual Taxes Paid Given a Mill Rate of		
	Rating	($/acre)	13	15	17
Black - AR 1-S					
Good Soil	0.92	343.73	4.47	5.16	5.84
Eroded	0.60	224.17	2.91	3.36	3.81
Thin Black - AR 1-NE					
Good Soil	0.77	287.69	3.74	4.32	4.89
Eroded	0.50	186.81	2.43	2.80	3.18
Saline	0.57	212.96	2.77	3.19	3.62
Dark Brown - AR 3A					
Good Soil	0.75	280.22	3.64	4.20	4.76
Eroded	0.23	85.93	1.12	1.29	1.46
Saline	0.32	119.56	1.55	1.79	2.03
Brown - AR 2A-N					
Good Soil	0.55	205.49	2.67	3.08	3.49
Eroded	0.18	67.25	0.87	1.01	1.14
Saline	0.24	89.67	1.17	1.35	1.52
Gray Luvisol - AR 2-HPR					
Good Soil	0.30	112.09	1.46	1.68	1.91
Eroded	0.18	67.25	0.87	1.01	1.14

Notes:

1. Soil Group and Agricultural Region (AR) are as defined in the 1984 Assessment Manual
2. Erosion in the Brown and Dark Brown Soil Zones is assumed to be by wind on sandy loam textured soils while that in the Black, Thin Black and Gray Luvisolic Soil Zones is assumed to be by water on clay loam soil.
3. The effect of salinity is only presented for the Thin Black, Dark Brown and Brown Soil Zones where salinity is most prevalent. Adverse subsoil conditions (e.g., solonetzic soils) are not considered.

Table 4.10.2

Impact of Soil Degradation (Erosion and Salinity) on Taxes Paid by Example Farms in Alberta

Example Farm	Tax Reduction[a] $/acre[b]	Tax Reduction[a] Total $[c]
Half Section Farm - Eroded		
Black AR 1-S	1.80	288.00
Thin Black AR 1-NE	1.52	243.20
Dark Brown AR 3A	2.91	465.60
Brown AR 2A-N	2.07	331.20
Gray Luvisol AR 2-HPR	0.67	107.20
Half Section Farm - Saline		
Thin Black AR 1-NE	1.13	180.80
Dark Brown AR 3A	2.41	385.60
Brown AR 2A-N	1.73	276.80
Two Section Farm - Eroded		
Black AR 1-S	1.80	1152.00
Thin Black AR 1-NE	1.52	972.80
Dark Brown AR 3A	2.91	1862.40
Brown AR 2A-N	2.07	1324.80
Gray Luvisol AR 2-HPR	0.67	428.80
Two Section Farm - Saline		
Thin Black AR 1-NE	1.13	723.20
Dark Brown AR 3A	2.41	1542.40
Brown AR 2A-N	1.73	1107.20

[a] Based on data in Table 4.10.1 using a mill rate of 15.

[b] Tax reduction per acre on the degraded soil as compared to soil of good quality.

[c] Based on 50% of total farm having the soil degradation problem noted.

Using the data from the examples in Table 4.10.1, the reduction of taxes paid as a result of soil degradation (erosion and salinity) is summarized in Table 4.10.2. The data illustrate that the tax reduction on the example farms is fairly significant. Depending on the size of farm, location, soil type, and severity of degradation, the tax reduction on the example farms ranged from $107.20 to $1,862.40 per farm. The average tax saving per degraded acre is estimated to be about $1.75 per acre.

The above-noted discussion does not include the resultant tax reductions where land is seriously eroded and assessed as non-arable pasture with a very low carrying capacity (e.g., marginal land converted to permanent cover or a grassed waterway) or assessed as having no agricultural economic value. There are cases where the affected land can have little or no tax applied to it (e.g., $0.00 tax for no agricultural economic value or only $0.15 to $0.25 per acre tax for pasture with a very low carrying capacity). These low or zero tax values seldom apply to a complete parcel of land owned by a farmer, but rather make up parts of the overall composite assessment and tax bill. In these very severe soil degradation situations, the tax reduction may be as high as $3.00 per acre depending on the original productivity of the affected land.

4.10.5 Impact of Municipal Farm Land Assessment Procedures on the Adoption of Soil Conservation Practices in Alberta

Land features which have a high potential for erosion are included in the rating system, and reduce the assessment and taxes paid. Once serious soil degradation has occurred, other factors (e.g., topsoil depth ratings which incorporate the effect of erosion and miscellaneous ratings that include the effect of salinity) reduce the assessment and taxes paid.

There are two opposing views regarding the impact that tax reductions have on conservation practices undertaken by farmers. One view suggests that the reduced tax burden provides farmers with the financial assistance needed to compensate them for the increased costs they must incur to prevent, control or reverse soil degradation. This view suggests the current assessment system encourages conservation. One negative aspect is that some of the factors (e.g., topsoil depth and salinity) do not result in a tax reduction until the degradation has become serious.

The opposite view is that the tax reduction resulting from serious erosion or salinity serves as a financial incentive to practices that result in soil erosion or salinity. The system is therefore seen as inhibiting the adoption of soil conservation practices in Alberta. The present farm land assessment system provides a larger tax reduction to seriously degraded farm land as compared to the system used prior to 1984.

The tax reduction due to soil degradation is not likely a major factor in the individual farmer's decision making. An annual saving of $1.75 per acre on average, or even of $3.00 per acre, in taxes on seriously degraded land (eroded or saline) is not adequate compensation for the extra costs of production.

The relationship between municipal farm land assessment and wetlands is also an issue. Wetlands are generally rated at their non-arable pasture value and/or rated lower on the basis of poor drainage, susceptibility to flooding and inconvenience (especially multiple sloughs which serve as multiple obstacles). The conservation concern arises when these wetlands are drained and as a result cause on-farm and off-farm erosion and destroy wildlife habitat. The assessment procedures result in a very low tax burden on these wetlands and in some cases result in a "no agricultural economic value" rating with no tax. This is not likely to encourage drainage, but rather should serve to retain these wetlands. If the tax load were high on these lands (e.g., the same as surrounding highly productive farm land), then there might be some incentive to drain them to obtain a net return. This, however, is unlikely. Any small tax paid on wetlands by farmers is unlikely to be viewed as a major consideration in the decision to drain as compared to the other considerations (e.g., field efficiency, increased productive land base, cost reductions, on-farm water management and weed control).

4.10.6 Survey Responses

Table 4.10.3 indicates a small but statistically significant proportion of farmers view their own management decisions as having been affected by assessment procedures. The pattern of effects (Table 4.10.4) is, however, difficult to assess. A majority of respondents cite no effect. Over three-quarters of respondents (Table 4.10.5) also cite no effect in their communities from the land assessment system, with a slight majority indicating a negative effect on area soil quality.

Table 4.10.3

Proportion of Farmers Whose Management Decisions were Affected by Farm Land Assessment Procedures

	Number of Responses (% of Responses to Respective Question)				
	South	Central Black	Central Gray	Peace River	All Regions[a]
Farmers feeling their management decision have or will be affected by assessment	35 (11.3)	52 (15.8)	16 (14.8)	17 (13.5)	120 (13.7)
Will not be affected by assessment	274 (88.7)	277 (84.2)	92 (85.2)	109 (86.5)	759 (86.3)
No response	7	5	0	0	12
Total responses	316	334	108	126	891

a Including responses without location coding.
Source: Questionnaire responses.

Table 4.10.4
Effect of the Farm Land Assessment on Farmers' Own Operations in the 1980's

Region - South	Number of Responses (% of Those Responding)			
Total Responses - 316	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	265	10 (19.6)	39 (76.5)	2 (3.9)
Summerfallow acreage	265	3 (5.9)	41 (80.4)	7 (13.7)
Forage acreage	269	5 (10.6)	40 (85.1)	2 (4.3)
Inputs per acre	263	9 (17.0)	37 (69.8)	7 (13.2)
Tillage operations	267	2 (4.1)	39 (79.6)	8 (16.3)
Livestock production	269	9 (19.1)	35 (74.5)	3 (6.4)
Region - Central Black	Number of Responses (% of Those Responding)			
Total Responses - 334	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	276	15 (25.9)	35 (60.3)	8 (13.8)
Summerfallow acreage	277	2 (3.5)	41 (71.9)	14 (24.6)
Forage acreage	280	13 (24.1)	34 (63.0)	7 (13.0)
Inputs per acre	275	19 (32.2)	31 (52.5)	9 (15.3)
Tillage operations	279	11 (20.0)	36 (65.5)	8 (14.5)
Livestock production	276	16 (27.6)	34 (58.6)	8 (13.8)
Region - Central Gray	Number of Responses (% of Those Responding)			
Total Responses - 108	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	84	6 (25.0)	15 (62.5)	3 (12.5)
Summerfallow acreage	86	3 (13.6)	14 (63.6)	5 (22.7)
Forage acreage	85	10 (43.5)	11 (47.8)	2 (8.7)
Inputs per acre	87	1 (4.8)	16 (76.2)	4 (19.0)
Tillage operations	86	2 (9.1)	17 (77.3)	3 (13.6)
Livestock production	86	13 (59.1)	9 (40.9)	0 (0.0)
Region - Peace River	Number of Responses (% of Those Responding)			
Total Responses - 126	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	108	3 (16.7)	13 (72.2)	2 (11.1)
Summerfallow acreage	108	1 (5.6)	13 (72.2)	4 (22.2)
Forage acreage	108	4 (22.2)	12 (66.7)	2 (11.1)
Inputs per acre	108	0 (0.0)	14 (77.8)	4 (22.2)
Tillage operations	108	2 (11.1)	13 (72.2)	3 (16.7)
Livestock production	114	2 (16.7)	9 (75.0)	1 (8.3)
Province Summary	Number of Responses (% of Those Responding)			
Total Responses - 884	No Response	Increase	No Change	Decrease
Effect on:				
Cultivated acreage	733	34 (22.5)	102 (67.5)	15 (9.9)
Summerfallow acreage	736	9 (6.1)	109 (73.6)	30 (20.3)
Forage acreage	742	32 (22.5)	97 (68.3)	13 (9.2)
Inputs per acre	733	29 (19.2)	98 (64.9)	24 (15.9)
Tillage operations	740	17 (11.8)	105 (72.9)	22 (15.3)
Livestock production	745	40 (28.8)	87 (62.6)	12 (8.6)

Source: Questionnaire responses.

Table 4.10.5

Farmers' Estimates of Farm Land Assessment on the Quality of Agricultural Land in Their Communities

Effect[a]	Number of Responses (% of Those Responding)				
	South	Central Black	Central Gray	Peace River	All Regions[b]
Strongly Negative					
- 3	12 (4.2)	15 (4.9)	5 (5.2)	2 (1.8)	34 (4.2)
- 2	13 (4.6)	21 (6.9)	5 (5.2)	2 (1.8)	42 (5.2)
- 1	15 (5.3)	17 (5.6)	8 (8.2)	7 (6.3)	48 (6.0)
No Effect	272 (77.9)	222 (72.5)	74 (76.3)	91 (82.0)	614 (76.2)
+ 1	15 (5.3)	17 (5.6)	2 (2.1)	6 (5.4)	40 (5.0)
+ 2	5 (1.8)	4 (1.3)	1 (1.0)	1 (.9)	11 (1.4)
+ 3	3 (1.1)	10 (3.3)	2 (2.1)	2 (1.8)	17 (2.1)
Strongly Positive					
No Response	31	28	11	15	85
Total Responses	316	334	108	126	891

[a] Includes responses with no coding of location.

[b] The lower the rating the more the program is considered to have contributed to soil degradation. The higher the rating the more the program is viewed as being beneficial to soil quality in their region.

Source: Questionnaire responses.

4.10.7 Farm Land Assessment Effects

Few effects are reported by farmers, and there appears to be no economic incentive for farmer to degrade soil in order to reap the benefits of lower tax rates. *A priori*, we would expect current property tax assessments based on current land use to have a net positive impact on soil conservation. At the same time, since property taxes typically amount to only, say, 2 percent of total farm operating expenses, any measurable province-wide impacts (either positive or negative) are highly unlikely. Thus, while no property tax assessment system is likely to generate enthusiasm among those who must pay it, there is little or no concrete evidence that measurable effects on soil quality have emerged. Accordingly, no attempt is made in this study to model effects of the farm land assessment system on soil quality.

5 SUMMARY AND CONCLUSIONS

5.1 Introduction

The Canada-Alberta Accord on Soil and Water Conservation and Development states (Section 3.9) that "Government policies should support the adoption of soil and water conservation practices. Changes to policies that inhibit these practices should be pursued." Additionally, the Canada-Alberta Agreement on Soil Conservation includes objective (2.3.0) which states that Canada and Alberta will undertake to "... review government policies which inhibit the adoption of soil conservation practices."

The extent to which specific government policies and programs have inadvertently contributed to the degradation of the agricultural resource base in Alberta is not well understood. No comprehensive quantitative assessment has yet been conducted and no potential policy or program adjustments have been evaluated.

Thus, the present study has as its primary goal the assessment of the manner, and to the degree possible, the extent to which a number of programs have influenced on-farm land management decisions in a significant way.

From a methodological perspective, the central task is one of quantitatively linking program/policy parameters (A) to on-farm operational characteristics (B) which, in turn, had to be quantitatively linked to various indices of soil quality (C) in Alberta:

A		B		C
Policy or Program	-->	On-Farm Operational Characteristics	-->	Quality of Agricultural Soils

The A-B and B-C linkages are difficult to quantify. The real focus of the study is the A-C linkage.

The A-B linkages are quantified, in large part, by utilizing a mail questionnaire (Appendix C) to a random sample of about 5,000 producers in the province. The usable number of questionnaires returned was 891, a 17.6 percent response rate and about 2% of all commercial farmers in Alberta. This procedure was supplemented by in-depth telephone interviews with 20 of the initial respondents, and with various farm management specialists.

The B-C linkages were largely quantified utilizing a computer simulation model (EPIC) which mathematically linked rates of sheet and rill erosion due to both wind and water to eight other variable grouping: hydrology, weather, nutrient levels, soil temperature, tillage practices, plant growth, plant environmental control, and economics. Estimated rates of erosion (exclusive of adjustments for soil regeneration of redesposition) were, in turn, translated into projected crop productivity changes measured in terms of physical yields and net revenue. These indicative calculations were initially conducted for four agro-climatic regions in the province and then aggregated to represent the province as a whole. The particular crop districts and census divisions in each region are shown in Table 3.3. The programs selected for study are those shown in Table 5.1.

Table 5.1

Federal and Provincial Policies and Programs Which May Inhibit the Adoption of Soil Conservation Practices in Alberta

Group I - Transportation and Marketing Programs:

1. Western Grain Transportation Act (WGTA)
2. Canadian Wheat Board (CWB) Quota Policy

Group II - Safety Net and Income Support Programs:

3. Western Grain Stabilization Act (WGSA)
4. Farm Fuel Programs
5. Canada-Alberta Crop Insurance Program
6. Special Canadian Grains Program (SCGP)
7. Crop Drought Program

Group III - Resource Development Programs and Assessment Procedures:

8. Land Management Programs
9. Water Management Programs
10. Municipal Farm Land Assessment Procedures

Source: See Appendix A.

5.2 Summary of Findings

A number of approaches were utilized to develop a consensus with regard to the relative extent to which the ten designated programs/policies have an impact on the quality of agricultural soils in Alberta.

5.2.1 Overview

Evidence regarding the relative cost, and duration helps put the various programs into context, as summarized in accompanying Table 5.2. The very different scale and duration of the respective programs allowed the researchers to concentrate on the first five: WGTA, CWB quotas, WGSA, farm fuel rebates, and all-risk crop insurance. Prior research further suggested that the land management variables which might require particularly close scrutiny were potential changes in the cultivated acreage utilized for annual crop production and changes to crop rotations, especially as they related to summerfallow and forage acreages. The evolving land management technologies employed regarding tillage and fertilizer application levels were also considered critical.

Table 5.2
General Agricultural Program Characteristics and Anticipated Net Long-Term Impact on Soil Quality in Alberta

Program/Policy	Duration	Approx. Current Annual Gov't. Expenditure ($M)[a]	Approx. Farmers Impacted[b] Annually	Regional Coverage	Expected Prov-Impact
WGTA	1987-ongoing	225	50,000	province	--
CWB Quotas	1941-ongoing	--	46,000	province	-
WGSA	1976-ongoing	c	40,000	province	+
Farm Fuel Rebates	1974-ongoing	200	50,000	province	--
Canada-Alberta Crop Ins.	1959-ongoing	200	25,000	province	+
SCGP	1987-1988	280	50,000	province	negligible
Crop Drought Program	1989	98	13,000	S/SE	negligible
Crown Land Sales	ongoing	--	300	N + E	negligible
Water Management	ongoing	3	750	N/N Central	negligible
Farm Land Assessment	ongoing	--	50,000	provincial	?

[a] Farm cash receipts from crop production are typically about $2 billion per annum; realized net income from crop production is typically about $400 million.

[b] There are a total of 57,777 farmers in Alberta (*1986 Census of Agriculture*); about 50,000 commercial farmers.

[c] Highly variable during period.

5.2.2 EPIC Simulations

The EPIC simulation model was utilized to translate anticipated program-induced farm management changes into per acre erosion losses and its attendant yield (productivity) and revenue implications for a given soil type. Four soil types and associated climatic data were employed to approximately represent the four major agricultural regions of the province. For each soil/climate combination, the model was used to appraise different crop rotations with different technologies (tillage practices and input levels) to iteratively generate cumulative estimates of soil quality, yield, and revenue (which serves as a composite yield index) over "n" years. EPIC is a dynamic physical model but essentially a static economic model, using costs and prices fixed over time in nominal terms. Regional/provincial impacts and the dynamics of agricultural sector expansion on to more marginal cropland can only be generated by utilizing an appropriate post-simulation weighting procedure with respect to the various soil/climate combinations. The use of only four combinations largely precludes applying this study to assess the impact of land expansion on to more marginal land or the impact of more site-specific program initiatives.

Given this analytical framework, present and prior research regarding possible program impacts by way of changes to crop rotations, input levels, and/or tillage practices were simulated and the results subsequently aggregated, as summarized in accompanying Table 5.3.

5 SUMMARY AND CONCLUSIONS

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5.2.3 Survey Results

An attempt was made to develop an estimate of soil losses based on questionnaire survey responses. The basic formula employed was:[22]

$$\sum_{i=1}^{4} \sum_{j=1}^{4} (\Delta \quad Area) \quad (\Delta \quad Erosion)$$

where:

$$\Delta Area_{ij} = \left(\frac{\Delta \quad Net \quad Respondents}{Total \quad Regional \quad Respondents}\right) \quad (Total \quad Regional \quad Cropland) \quad (10\% \quad or \quad 1 \quad cultivation)$$

$$\Delta \quad Erosion_{ij} = (50 \quad Year \quad Erosion \quad without \quad Change) \quad less \quad (50 \quad Year \quad Erosion \quad with \quad Change)$$

and where:

i = South, Central Black, Central Gray, and Peace River regions.

j = Cultivated acreage, 3-rotation, weighting, number of tillage operations, and input levels.

Area changes were taken directly from the survey responses while projected erosion changes were again derived using EPIC. The basic EPIC simulations conducted to estimate per acre soil erosion levels over a 50 year period for three crop rotations in each of four regions were as follows: (1) existing situation; (2) pasture or idle land; (3) cropland with 10% more fertilizer; and (4) cropland with one less tillage operation.

The end result of this ranking procedure, which is also valid under some rather strict assumptions,[23] is illustrated in accompanying Table 5.4.

Table 5.4 underscores both a number of differences and a number of similarities with respect to our internally-generated estimates as per Table 5.3.

The most profound difference is the estimated relative size of the respective impacts; survey results in total are about one-tenth as large as those estimated by the EPIC simulation. This follows directly from the fact that the percentage of farmers who report any operational changes due to any of the programs here considered is relatively small. In no case does the percentage of respondents indicating some effect exceed one-third of all farmers; in other words, about 2/3 of all farmers do not believe these agricultural programs have any effect (either positive or negative) on their land management practices. Moreover, when specific management practices are considered, the net changes suggested are even smaller (Table 5.5).

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22 One m^3 of soil = 1 tonne.

23 For example, no response = zero response; a 1:1 ratio between farmers and cultivated land area; a plus-minus symmetry (to use a net figure); as well as no sample bias. Aggregate data from the *1986 Census of Agriculture* (Table 3.1).

Table 5.4

Simulated Soil Erosion Changes Attributed to Agricultural Programs in Alberta from the On-Farm Survey (million tonnes/50 years)

Program	South Region	Central Black	Central Gray	Peace River	Total M. Tonnes	Total Percent[a]
WGTA[b]	7.2	2.6	0.8	2.4	13.0	0.42
WGSA	4.1	3.5	1.7	5.8	15.1	0.49
CWB Quotas	8.8	2.6	0.3	4.1	15.8	0.51
Fuel Rebates	11.2	19.3	2.8	25.1	58.4	1.87
Crop Insurance	7.7	3.5	--	3.2	14.4	0.46
SCGP[c]	0.3	--	--	0.4	0.7	0.02
Drought[c]	(0.1)	--	--	--	(0.1)	--
Assessment	2.8	3.6	0.7	(0.3)	6.8	0.20
TOTAL						
M. Tonnes	42.0	35.1	6.3	40.7	124.1	
Percent	3.1	3.9	2.0	7.6	4.0	

[a] Does not consider soil redeposition or regeneration. Neither does it estimate gully or ephemeral gully erosion. Also ignores other soil quality criteria (salinity, organic matter, acidity, tilth, etc.). See footnotes in accompanying Table 5.3.

[b] Excludes any potential impacts from tillage practices.

[c] Estimated assuming ever-diminishing impacts (100%-80%-60%-40%-20%) over a five year period. For simplicity, the initial one-year impact was also assumed to be equal to 1/50 of the estimated 50 year impact. (SCGP: full impact for 2 years).

Source: Basic data from own-farm survey results and EPIC simulations.

Table 5.5

Proportion of Survey Respondents Reporting Operational Changes in Response to Selected Agricultural Program Initiatives

Program	% Who Report Effect	Net Percent Reporting an On-Farm Change in:[a] Cultivated Acres	Fallow Acres	Forage Acres	Inputs Per Acre	Tillage Operations	Livestock Production
WGTA	33.6	12.4	-6.1	8.7	4.5	-5.1	8.9
WGSA	15.0	4.6	-4.8	2.1	6.0	0.0	3.3
CWB Quotas	23.7	7.0	-8.2	4.9	5.2	-0.4	4.6
Fuel Rebates	28.6	9.9	1.3	4.9	7.9	9.7	4.2
Crop Insurance	12.9	4.2	-3.6	0.9	4.2	-0.5	2.7
SCGP	11.3	2.7	-2.4	0.5	1.9	-0.4	1.9
CCDAP	4.7	-0.1	-0.2	0.7	-0.2	-1.8	0.7
Land[b]	5.8						
Water[b]	14.6						
Assessment	13.5	2.5	-2.4	2.3	0.7	-0.4	3.1

[a] No. of responses indicating an increase less the number of responses indicating a decrease; all divided by the total number of responses x 100.

[b] On-farm changes not reported in the same format.

Yet another significant difference is the identified sources of erosion. Whereas our independent analysis focused on potential changes to crop rotations (crop mixes) and tillage practices (the latter solely with respect to fuel rebates), the farm survey responses emphasize increased cultivation of previously uncultivated land as being primarily responsible for most on-farm erosion impacts associated with the programs here considered:

Increased Cultivation	73%
Input Changes	1%
Tillage Practices	26%

On the other hand, the survey results do re-emphasize the relatively important negative consequences of the first five programs (as per Table 5.3), and, in particular, the perceived negative impact of farm fuel rebates on soil consideration. Responses to *ad hoc* one-time programs such as the SCGP and 1989 Drought Programs appeared especially muted, while production insurance programs (Crop Insurance and WGSA) apparently have a very modest impact on land management on about 15 percent of all farms. Survey responses with respect to the potential impact of Crown Land dispositions and water management programs on soil quality were not amenable to this type of aggregate ranking procedure.

For whatever reason or reasons, therefore, most farmers simply do not believe that they have made (or would make) any significant land management changes in response to these programs (or possible program changes). Perceived impacts of these programs on soil erosion in their community, however, demonstrates still more incongruities, as illustrated in Table 5.6. The five worst programs in terms of soil conservation in their community, as perceived by farmers, are:

Crop Insurance
WGTA
Crown Land Sales
Farm Fuel Rebates, &
CWB Quotas

This ranking differs from their stated management responses on their own farm (Table 5.4) and from the study assessment as per Table 5.3.

In short, Table 5.4 reinforces the initial assessment (Table 5.3) that farm fuel rebates probably do have a relatively large negative long-term impact on soil quality. The perception (Table 5.6) that Crown Lands and the WGTA have also had a relatively large negative impact on soil quality is also consistent with Table 5.3.

In addition, two points which seem to be consistently reinforced are:

1. WGSA, SCGP, and CCDAP programs are relatively insignificant in terms of long-term impacts on soil erosion, and
2. Water management programs appear to have a small net positive impact on soil quality.

Analysis of the farm survey responses suggests that some of the more apparent inconsistencies reported may stem from: (1) a limited understanding of various program initiatives, and/or (2) the perceived positive impact on soil erosion of short-term income effects.

Table 5.6

Farmer Perceptions of Effect of Programs on Soil Quality in their Communities

Program		Number of Responses				Weighted Responses[a]	
		Negative Effect	Neutral	Positive Effect	Total	Index	Rank (1=worst)
(1)	WGTA	163	573	85	821	-134	2
(2)	WGSA	90	644	108	842	21	(+)6
(3)	CWB Quota	135	599	118	852	-67	5
(4)	Farm Fuel Rebates	126	577	141	844	76	(+)9
(5)	Crop Insurance	192	520	116	828	-191	1
(6)	SCGP	87	604	124	815	47	(+)7
(7)	Crop Drought Program	55	651	90	796	53	(+)8
(8)	Crown Land Sales	114	559	55	728	-128	3
(9)	Water Management Programs	73	417	261	751	307	(+)10
(10)	Farm Land Assessment	124	614	68	806	-121	4

[a] Based on weighted average of seven possible rankings, from strongly negative effects on soil quality to strongly positive effects; "+" indicates perception of soil improvement due to the program.

Source: Based on questionnaire returns.

5.3 Research and Policy Implications

Principal limitations of the study are the following:

1. This study is a preliminary province-wide quantitative and qualitative analysis of the long-term impact of agricultural programs on soil quality. All quantitative estimates are only considered generally indicative of their actual magnitude. Its macro-focus is reflected in the decision to use only four general soil types to characterize some 30 million acres.
2. The measure of soil loss used in the study is soil erosion due to wind and water. Erosion, as here used, is a narrow definition and is used as a proxy variable for the numerous other variables which, together, more properly determine soil "quality": nutrient levels, organic matter content, tilth, salinity levels, acidity levels, etc.
3. Adapting the simulation model, EPIC, to Alberta conditions was also difficult because no comprehensive computerized data file for Alberta soils is readily available. The present incomplete status of similar soil models in Alberta also makes model calibration/validation inherently difficult. Estimated rates-of-erosion in border states, as discussed in Chapter 2, are at the upper range of those calculated herein.
4. Finally, a partial analysis which evaluates the impact of each program separately may not be additive. The essence of this argument is that, separately, each program may be relatively resource-neutral but together there may be an environment created which might affect farm management decisions regarding land use. In effect, this hypothesis postulates that the policy "package" becomes a significant

part of the social-institutional-economic decision-making framework of the farmer. This intuitively appealing proposition would imply systemic underestimation of program impacts as documented herein.[24]

Follow-up research should therefore focus upon the following:

1. Physical Research:
   a. Preparation of a readily available comprehensive computerized data base profiling various Alberta soils. This is a prerequisite for virtually all subsequent studies regarding Alberta-wide soil degradation characteristics; especially if complex simulation models (with very extensive data requirements) are employed.
   b. Province-wide soil degradation studies should adopt various (more comprehensive) definitions of soil quality with respect to sheet and rill erosion due to both wind and water and simultaneously redesposition. Off-site ramifications should also be considered. Macro- (regional and sub-regional) models must be employed. Existing simulation models should be adapted accordingly.
   c. The number of soil profiles (representing sub-regions which in turn, represent the whole of the province) which must be considered in the above context would desirably be expanded, say, to twelve, i.e. 4 sub-regions x 3 soil types for each sub-region. Even more data resolution is highly desired (over time), assuming that data accessibility, data versatility, and inter-disciplinary utility can be maintained or enhanced.
   d. Soil degradation models must be calibrated and made comparable to other studies in the U.S. and elsewhere in Canada. An extensive sensitivity analysis with respect to numerous physical variables should be an integral part of this verification process.
2. Impact Analysis:
   a. Farm management adjustments to government policy (i.e. A-B linkages) should be further scrutinized. Further research must focus on adjustments on a given land base and an expanded land base, particularly the latter. This might include new approaches to assessing the impact of the policy environment on management decisions.
   b. The impact of farm management practices on soil quality in sub-regions throughout Alberta (i.e. B-C linkage) should also be further assessed on a comprehensive basis. This research can, however, only proceed in conjunction with or following the principal physical research requirements indicated above.
   c. Existing static micro-simulation models should be further refined to incorporate technological and economic change (costs and prices) and regional aggregation into the cumulative soil degradation process.
   d. In the above context, the government policies of particular concern might be focussed on the WGTA, farm fuel rebates, Crown land dispositions, CWB quotas, and crop insurance.

The ongoing Alberta-Canada review of government policies may seek further support than that embodied in this study. Such analysis might, however, focus on a limited number (say the "top 5" of the policies indicated here. It may also choose to focus on the impact of these policies on selected regions, with particular soil types, slopes and climatic conditions.

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24 There have been attempts to deal with the effect of U.S. farm programs in the context of their effect on overall farmer attitudes, particularly via a focus on risk aversion implications (e.g. Miranda and Helmberger 1988).

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7 APPENDICES

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APPENDIX A - TERMS OF REFERENCE

Introduction

The Canada-Alberta Accord on Soil and Water Conservation and Development states (Section 3.9) that "Government policies should support the adoption of soil and water conservation practices. Changes to policies that inhibit these practices should be pursued." Additionally, the Canada-Alberta Agreement on Soil Conservation includes objective (2.3.0) which states that Canada and Alberta will undertake to "... review government policies which inhibit the adoption of soil conservation practices."

The extent to which specific government policies and programs have inadvertently contributed to the degradation of the agricultural resource base in Alberta is not well understood. No comprehensive quantitative assessment has yet been conducted and no potential policy or program adjustments have been evaluated.

Thus, at the request of Alberta Agriculture/PFRA, this research proposal is being prepared by the Department of Rural Economy, University of Alberta to outline how this evaluation could be successfully conducted during the period December 1989 - June 1990.

Study Objectives

The general objective of this project research is to assess producer attitudes and provide a quantitative assessment of the extent to which the policies and programs listed in accompanying Table 1 influence the adoption of soil conservation practices in Alberta. With regard to each of the policies or programs listed in Table 1, the more specific objectives are the following:

1. Identify, through a review of relevant literature, and through a survey of farmers attitudes and views, the probable impacts on the adoption and use of good land management and soil conservation practices to prevent wind erosion, water erosion, salinization, and organic matter depletion;
2. Quantify the farm level impacts of the policies and programs identified in the study. This will include an analysis of the impact on farm cost structures and revenues resulting from each policy or program and of the extent to which the combined economic effects across all programs being studied detract from the farm level adoption of soil conserving measures in the main eco-regions of Alberta;
3. Identify potential adjustments to policies and programs that would reduce or eliminate any adverse impacts with regard to soil degradation, and
4. Identify data gaps and make recommendations regarding future data gathering activities.

Methodology

General Approach

From a methodological perspective, the central task was one of quantitatively linking program/policy parameters to on-farm operational characteristics which, in turn, must be quantitatively linked to wind erosion, water erosion, salinization, and organic matter depletion in Alberta agriculture:

A		B		C
Policy or Program	-->	On-Farm Operational Characteristics	-->	Soil Degradation

The A-B and B-C linkages are difficult to quantify. The A-C linkage is the real focus of the proposed research.

Table 1

Federal and Provincial Policies and Programs Which May Inhibit the Adoption of Soil Conservation Practices in Alberta

Group I - Transportation and Marketing Programs:

1. Western Grain Transportation Act (WGTA)
2. Canadian Wheat Board (CWB) Quota Policy

Group II - Safety Net and Income Support Programs:

3. Western Grain Stabilization Act (WGSA)
4. Farm Fuel Programs
   - federal - excise tax reductions
   - provincial - Alberta Farm Fuel Distribution Allowance (AFFDA) and tax concessions
5. Canada-Alberta Crop Insurance Program
6. Special Canadian Grains Program (SCGP)
7. Crop Drought Program

Group III - Land Development Programs and Assessment Procedures:

8. Land Clearing Programs, i.e.,
   - Programs which may contribute to the clearing of degradation prone land
   - Public Land Disposition
   - Accelerated Land Sales Program
   - ADC Range and Soil Improvement Loan Program
9. Drainage Programs, i.e.,
   - Programs which may contribute to the development of degradation prone lands
   - Cost Shared Water Resource Management Projects
   - Farmland Development and Reclamation Program (FDRP)
10. Municipal Farm Land Assessment Procedures

In terms of both A-B and B-C linkages, the general methodology employed (for each policy/program listed in Table 1) would be similar:

1. Literature Review
2. Producer Survey
3. Quantitative Modelling
4. Aggregate Assessment
5. Policy/Research Implications

The specific activities conducted under each of these sub-headings will be unique to each of ten programs/policies being considered. The general *modus operandi*, however, can be outlined as provided following.

Study Procedure

For each policy/program, the principal methodological steps involved could also be similar.

Literature Review

Although no comprehensive research consistent with the objectives of this study has ever been conducted, numerous related studies of specific programs/policies are readily available.

Identifying the reasons for this degradation and identifying the policy/program parameters which impact on these on-farm operational characteristics (as well as subsequently quantifying the strength of these linkages) is the real task confronting the research team during the literature review process. Expertise in soil fertility and management will be especially critical at this stage.

Producer Survey

A producer survey, by region and farm type (especially grain versus livestock) is an integral and mandatory component of this research because: (a) it will help identify A-B linkages; (b) it will contribute to filling outstanding primary data gaps; (c) it may assist in identifying research priorities required on each policy/program; and (d) it may serve as a partial "check" on the validity of independent bu parallel research.

The proposed survey would be a mail-out survey to about 3,000 producers. The sample would be stratified by region and farm-type. Follow-up mail-outs will be utilized with goal of a 30% (1,000) response-rate. The fall-back approach, if needed, is likely to involve telephone administration of the study questionnaire.

Design of the questionnaire must follow an initial review of the existing literature. It is anticipated, however, that it would consist of about 20 structured questions and be about 5 pages in length.

Work on this survey (questions and pre-testing) would be initiated during the early stages of this study to be completed at about the midpoint.

Quantitative Modelling

The modelling conducted to quantify the various linkages (both A-B and B-C_ would be unique to each policy/program considered. In general, however, this would involve a combination of:

- non-stochastic farm simulation models,
- stochastic econometric models, and
- farm/regional budgeting

Wherever possible, existing models would be adapted for the particular task at hand. It is not anticipated that large, complex models (which are notoriously difficult to verify) will be developed during the course of this work. The study team will studiously avoid the "black box" approach to economic analysis and report preparation. The focus will be on form level model where possible, and inferring practices from the models or questionnaire results.

Aggregate Assessment

It is anticipated that all modelling will be "rolled-up" into regional sub-totals prior to obtaining province-wide estimates. Where necessary, this would also be specific to grain and livestock producers.

Policy/Research Implications

The program/policy implications will then be tracked, largely by conducting various sensitivity tests on the respective models. By changing program/policy parameters, the sensitivity to various program/policy changes can be quantified. Generalized linkage elasticities can then be generated. Proposed structural changes will require model re-specification and re-calculation of the degree to which this change impacts on soil degradation over time.

Research implications primarily refer to the need to identify the particular strengths and weaknesses of the research conducted, particularly the degree of accuracy and reliability the various empirical results exhibit. Outstanding data needs must also be identified.

Study Output

A report will be prepared which will be organized approximately as follows:

Section 1 - Introduction

- 1.1 Overview of degradation (mainly physical)
- 1.2 Review of possible links to policies/progress
- 1.3 Current knowledge of "good" land management practice in Alberta
- 1.4 Objectives and approach to research

Section 2 - Program/Policy Evaluation #1

- 2.1 Description
- 2.2 Linkages
- 2.3 Quantitative assessment
- 2.4 General assessment

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Section 11 - Program/Policy Evaluation #10

Section 12 - Aggregate Assessment

Section 13 - Policy/Research Implications

Appendix A - Study Terms of Reference

Appendix B - Profile of Soil Degradation in Alberta

Appendix C - Summary of Questionnaire Responses

APPENDIX B - EPIC MODEL SUMMARY AND DISCUSSION

EPIC Input Data

While estimates exist of soil loss in Canada as well as the U.S., it is difficult to translate a soil loss in tonnes to a specific dollar value or productivity loss. Since previous estimates of the costs of erosion in Alberta have been marginal to non-existent, the EPIC program has been a valuable tool in extending and clarifying our knowledge of this issue.

The credit for this model goes to the USDA's Agricultural Research Service through whom the model was developed by Jimmy Williams in Temple, Texas. Verel Benson, also of the Temple Research Station was most helpful in providing a copy of the latest version of the model, while both provided valuable assistance in understanding parts of the model and offering further instruction through courses as needed. Cesar Izaurraulde of the University of Alberta, Department of Soil Science also provided valuable assistance in comprehending and running the model for the purposes of this study. The EPIC model has been tested by the University in plots at Ellerslie with current studies underway at Breton.

Agriculture Canada provided soil pedons for various locations in Alberta, as well as estimates of slope steepness, slope length, and dominant soils for selected agricultural resource areas. A more thorough examination of pedons and other input data would have been useful for this study, but was not feasible in the time allotted for the study, it may be undertaken by future studies which wish to pursue a more rigorous detail. Josef Tajek and Gerda Coen, of the Alberta Soil Survey Unit, were particularly instrumental in providing information for this study.

Input Data Required

The Erosion-Productivity Impact Calculator (EPIC) model simulates plant growth in an agricultural production model. The input data required can be generally grouped into the three areas of soil, climate and crop management. Input data are extremely extensive, but the model is designed so that if some of the lesser important items are missing they can be estimated from other sources, including data files provided with the study. The Temple Research Station is collecting and updating these files constantly so that the model can be used more extensively and with greater ease and accuracy.

Much of the management data can be chosen by the user in order to vary inputs for the purposes of the study. While weather data was complex and initially foreboding, it is readily available from secondary sources. Some data had to be estimated as Canadian weather records are not as detailed as in the U.S. (or would be costly to obtain), while some data is simply not recorded or calculated from the information kept.

Soil and Land Form Data

Delays were experienced in obtaining appropriate soil pedons. An effort was made to use the most extensive soil pedon for a given region. The question, however, is which region. Having divided the province into four regions (the South, Central Black, Central Gray, and Peace River), it was hoped to obtain the most common soil pedon for each region. Pedons for the Peace River area, however, while available from various sources, are incomplete for the soils needed for the study, and not computer-assessible as are similar data for the other regions. Instead of a pedon from that area, the pedon for the Central Gray - Luvisolic area was used for this region.[25] Pedons for soils in the South, Central Black, and Central Gray regions were available. The most common soils were grouped by agroecological resource area, and in some cases may not have been the most common soil for the entire region.

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25 Appendix Table B.10 provides erosion estimates for several rotations in the Peace River region, using a gray wooded soil profile for the region. The profile became available late in the study, and comparative erosion rates for the study soil profile as well as the Peace River profile are shown to compare erosion rates with similar rotations. The results, in general, show slightly (5-10%) higher rates of erosion using the Peace Region soil profile.

Since the EPIC model is designed to measure erosion for a specific field, generalities must be used in extending the model to a much larger area. In addition to choosing one from among a wide variety of soil pedons, one of the most crucial steps is estimating slope steepness and slope length for a typical field over a large area. If water erosion increases much more rapidly with a steeper slope, mean approximations of the slope over a large area could underestimate erosion potential. In the Peace River, a relatively gentle slope with very long fields and hence a long channel length may lead to extensive water erosion problems. Some estimates of the slope length and steepness for selected agroecological resource areas were provided by Agriculture Canada, while general estimates were available in Agriculture Canada. 1985. *Water Erosion Potential of Soils in Alberta.*

The type of data required for the soil pedon were number and depth of soil layers (or horizons), soil albedo (for surface radiation), minimum and maximum depth to water table, and for each layer, the bulk density, wilting point, field capacity, sand and silt content (model calculates clay content), soil pH, organic carbon, calcium carbonate, and various other data which would be useful, but were not always required. Organic nitrogen and phosphorus concentration depended on the amount of fertilizer used and vary from soil to soil.

Weather Data

Weather data are important to determine plant growth, and to estimate wind and water erosion. After determining field size, length, slope, roughness factors, and other assorted data peculiar to EPIC, necessary weather data included frequency of rainfall, minimum and maximum average monthly air temperatures, standard deviation of monthly temperature, average number of days of rain per month, maximum 1/2 hour rainfall by month, monthly average daily solar radiation, monthly average relative humidity and data on wind direction and velocity.

Some frequency of rainfall data were not available in the same form as in the U.S. and had to be estimated from existing information. In particular, use was made of J.P. Bruce. 1985. *Atlas of Rainfall Intensity - Duration Frequency Data for Canada*. Department of Transport: Meteorological Branch, for estimates of the frequency of rainfall.

Other data were obtained from Environment Canada, 1982. *Canadian Climate Normals 1951 to 1980, (Temperature and Precipitation) Prairie Provinces.*

Wind data are only available for major centre or airport locations. In Southern Alberta, Lethbridge, Medicine Hat, or Calgary data could be used. Lethbridge was chosen because of proximity to the Warner soil pedon which was used for the South. Camrose was chosen for the Central Black soil zone as much of the Angus-Ridge loam soil was in this area. For this soil pedon, Edmonton International wind data were used.

For the Central Gray region, the Breton research plot of the University of Alberta, is located on a soil type which is common in the Gray-Luvisolic area west of Edmonton. This pedon was called Breton Loam-Gray Luvisolic, but Edmonton weather data were used. Had the soil pedon been from the Gray Luvisolic area north and northeast of Edmonton, Lac La Biche or Cold Lake could have been chosen.

The Peace River region had a choice of four locations for weather data: Grande Prairie, Peace River, Fairview, and High Level. While much of the soil near Grande Prairie is actually black loam, the weather data for Grande Prairie was, nevertheless chosen to represent that area.

Solar radiation is the least available of all the weather data as it requires precise and sometimes difficult instrumentation and testing procedures to be recorded consistently and accurately. Only selected weather stations record this data with some effort to record at geographically distant locations to cover a broader base. The only locations available are Beaverlodge, Edmonton (municipal and Stony Plain), and Suffield. Suffield was chosen for the South, Beaverlodge for the north, and the closest Edmonton airport for the central locations.

Table B.1a
Input Assumptions for EPIC Program Analysis

Region/EPIC Run	Rotation	% of Area	Fertilizer Applied (kg/ha)	Type of Tillage	Land Length (L) and Steepness (S)
South:					
Pre-WGTA	1. wheat/wheat/fallow	.4	30 - N	Standard	L - 85 m
	2. wheat/barley/fallow	.4	30 - P		S - .06 m/m
	3. wheat/canola/barley/barley	.2			
Post-WGTA	1. wheat/wheat/fallow	.5	29.3 - N	Standard	L - 85 m
	2. wheat/canola/barley/barley	.3	26.8 - P		S - .06 m/m
	3. wheat/barley/barley/forage/forage	.2	(varies)		
WGSA	1. wheat/wheat/fallow	.4	33 - N	Standard	L - 85 m
	2. wheat/barley/fallow	.4	33 - P		S - .06 m/m
	3. wheat/canola/barley/barley	.2			
Fuel Rebate	1. wheat/wheat/fallow	.4	33 - N	Air Seeded	L - 85 m
	2. wheat/barley/fallow	.4	33 - P		S - .06 m/m
	3. wheat/canola/barley/barley	.2			

Table B.1b
Input Assumptions for EPIC Program Analysis

Region/EPIC Run	Rotation	% of Area	Fertilizer Applied (kg/ha)	Type of Tillage	Land Length (L) and Steepness (S)
Central Black:					
Pre-WGTA	1. wheat/barley/fallow	.4	50 - N	Standard	L - 85 m
	2. wheat/canola/barley/barley	.3	30 - P		S - .06 m/m
	3. canola/barley/barley/forage/forage	.3			
Post-WGTA	1. wheat/barley/fallow	.3	49.3 - N	Standard	L - 85 m
	2. wheat/canola/barley/barley	.3	26.8 - P		S - .06 m/m
	3. cancola/barley/barley/forage/forage	.4	(varies)		
WGSA	1. wheat/barley/fallow	.4	55 - N	Standard	L - 85 m
	2. wheat/canola/barley/barley	.3	33 - P		S - .06 m/m
	3. canola/barley/barley/forage/forage	.3			
Fuel Rebate	1. wheat/barley/fallow	.4	50 - N	Air Seeded	L - 85 m
	2. wheat/canola/barley/barley	.3	30 - P		S - .06 m/m
	3. canola/barley/barley/forage/forage	.3			

Table B.1c

Input Assumptions for EPIC Program Analysis

Region/EPIC Run	Rotation	% of Area	Fertilizer Applied (kg/ha)	Type of Tillage	Land Length (L) and Steepness (S)
South:					
Pre-WGTA	1. wheat/barley/barley/fallow	.3	40 - N	Standard	L - 85 m
	2. wheat/barley/forage/forage	.3	20 - P		S - .06 m/m
	3. canola/barley/forage/forage	.4			
Post-WGTA	1. wheat/barley/barley/fallow	.2	39.3 - N	Standard	L - 85 m
	2. wheat/barley/forage/forage	.4	16.8 - P		S - .06 m/m
	3. canola/barley/forage/forage	.4	(varies)		
WGSA	1. wheat/barley/barley/fallow	.3	44 - N	Standard	L - 85 m
	2. wheat/barley/forage/forage	.3	22 - P		S - .06 m/m
	3. canola/barley/forage/forage	.4			
Fuel Rebate	1. wheat/barley/barley/fallow	.3	40 - N	Air Seeded	L - 85 m
	2. wheat/barley/forage/forage	.3	20 - P		S - .06 m/m
	3. canola/barley/forage/forage	.4			

Table B.2a
Average Monthly Weather Data for EPIC - Warner (South)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature (°C)												
Maximum	-4.5	.30	3.9	11.2	17.7	22.0	26.1	24.9	19.7	14.1	5.0	0.0
Minimum	-16.0	-11.0	-8.1	-1.4	4.3	8.8	11.0	10.1	5.6	.8	-6.5	-11.4
Standard Deviation[a]	11.4	9.7	8.5	7.0	6.4	5.8	5.9	6.2	6.9	7.1	8.6	10.0
	(4.9)	(4.4)	(3.2)	(2.6)	(1.5)	(1.6)	(1.2)	(1.8)	(2.3)	(2.3)	(3.6)	(4.4)
Rainfall (mm)	23.6	18.9	24.2	42.7	50.8	78.2	43.5	47.1	37.2	17.8	16.8	21.9
Standard Deviation	12.5	13.6	13.5	28.2	32.2	46.9	32.6	36.5	29.0	17.4	13.4	14.0
Days of Rain[b]	8.54	6.90	6.15	7.48	9.42	11.44	6.62	6.47	6.70	4.95	5.30	6.46
	(11)	(8)	(9)	(9)	(10)	(10)	(8)	(8)	(7)	(6)	(7)	(9)
Maximum 1/2 hr. Rainfall (mm)	4.9	6.4	8.0	14.3	22.4	18.8	12.5	17.9	12.9	10.2	9.9	5.7
Solar Radiation (mj/m^2)[c]	6	9	15	18	22	24	27	22	17	11	6	4
	(5)	(9)	(14)	(18)	(22)	(24)	(25)	(20)	(14)	(9)	(5)	(4)
Relative Humidity (%)	73	71	69	63	57	57	56	57	60	59	67	70

Ten Year Frequency of 1/2 Hour Rainfall - 25 mm.
Ten Year Frequency of 6 Hour Rainfall - 45 mm.
Elevation of Watershed[d] - 823 m (929 m).
Latitude of Watershed - 49 degrees 38 sec.

[a] Correction in brackets for standard deviation of daily temperature using Lethbridge A data.

[b] Correction for number of days of rain using Lethbridge A data in brackets.

[c] Radiation data for nearby locations in the U.S. were used for the Warner runs of EPIC. Radiationdata for Suffield appear in brackets.

[d] Correction for elevation in brackets.

Table B.2b
Average Monthly Weather Data for EPIC - Camrose (Central Black)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature (°C)												
Maximum	-11.9	-6.1	-1.1	9.3	17.1	20.4	22.8	21.6	16.2	10.8	0.0	-7.0
Minimum	-21.9	-17.6	-12.6	-2.8	4.1	8.4	10.6	9.3	4.0	-1.8	-9.8	-17.0
Standard Deviation[a]	4.3	4.0	3.4	2.8	1.4	1.4	.9	1.7	1.9	1.8	4.0	4.4
					(1.4)	(1.4)						
Rainfall (mm)	27.0	19.1	19.7	19.6	46.0	79.6	74.1	74.4	39.7	15.4	16.8	21.8
Standard Deviation	16.2	11.9	13.8	15.6	31.0	46.9	32.6	47.4	31.3	16.3	13.7	13.2
Days of Rain[b]	8.54	6.90	6.15	7.48	9.42	11.44	6.62	6.47	6.70	4.95	5.30	6.46
	(10)	(7)	(7)	(5)	(9)	(11)	(12)	(10)	(9)	(4)	(5)	(7)
Maximum 1/2 hr. Rainfall (mm)	10.7	8.0	9.7	13.1	16.4	22.9	26.2	38.4	13.8	8.4	9.7	8.8
Solar Radiation (mj/m^2)	4	7	13	17	21	23	23	18	13	8	4	3
Relative Humidity (%)	73	74	75	66	58	66	73	75	74	69	76	76

Ten Year Frequency of 1/2 Hour Rainfall - 31 mm.
Ten Year Frequency of 6 Hour Rainfall - 53 mm.
Elevation of Watershed - 732 m.
Latitude of Watershed - 53 degrees 1 sec.

[a] A portion of the standard deviation data was entered incorrectly, i.e. in brackets.

[b] Correction for days of rain apperas in brackets.

Table B.2c

Average Monthly Weather Data for EPIC - Breton/Edmonton (Central Gray)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature (°C)												
Maximum	-10.9	-5.6	-.9	93.	17.2	20.8	22.4	21.5	16.5	11.4	-.1	-7.5
Minimum	-22.0	-17.1	-12.4	-2.9	3.0	7.3	9.2	8.1	3.1	-2.1	-10.9	-18.5
Standard Deviation	4.7	4.6	38	2.5	1.1	1.5	1.1	1.9	2.2	1.8	3.6	4.3
Rainfall (mm)	24.4	17.6	16.0	20.2	42.2	76.7	91.6	78.2	45.7	15.4	16.7	21.9
Standard Deviation	14.1	9.5	9.7	11.1	26.1	41.6	26.3	44.5	31.0	11.8	11.1	8.9
Days of Rain[a]	8.54 (12)	6.90 (10)	6.15 (11)	7.48 (8)	9.42 (10)	11.44 (15)	6.62 (14)	6.47 (13)	6.70 (11)	4.95 (7)	5.30 (8)	6.46 (11)
Maximum 1/2 hr. Rainfall (mm)	6.1	6.7	8.3	9.0	14.4	29.6	22.0	31.0	27.0	12.7	6.3	6.9
Solar Radiation (mj/m^2)	4	7	12	18	20	22	22	18	12	8	4	3
Relative Humidity (%)	73	74	75	66	58	66	73	75	74	69	76	76

Ten Year Frequency of 1/2 Hour Rainfall - 32 mm.
Ten Year Frequency of 6 Hour Rainfall - 53 mm.
Elevation of Watershed[b] - 671 m (766 m).
Latitude of Watershed - 53 degrees 33 sec.

[a] Correction for number of days with rain using Edmonton/Stony Plain data.

[b] Corrected elevation is for Edmonton/Stony Plain.

Table B.2d

Average Monthly Weather Data for EPIC - Grande Prairie (Peace River)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Temperature (°C)												
Maximum	-12.4	-6.5	-1.5	8.4	16.4	19.9	22.1	21.1	15.9	9.9	-1.1	-8.2
Minimum	-23.0	-17.7	-12.9	-3.1	3.6	7.5	9.7	8.4	3.7	-1.6	-10.8	-18.6
Standard Deviation[a]	5.4	4.7	2.9	2.6	1.2	1.0	1.0	1.4	1.8	2.0	4.4 (4.4)	4.6
Rainfall (mm)	23.9	23.7	20.8	19.5	36.0	70.0	65.1	60.5	37.4	26.6	27.8	32.0
Standard Deviation	20.3	14.9	10.6	11.2	23.9	46.7	41.3	32.5	24.5	19.2	16.0	17.2
Days of Rain[b]	8.54 (14)	6.90 (11)	6.15 (11)	7.48 (8)	9.42 (9)	11.44 (12)	6.62 (13)	6.47 (12)	6.70 (11_	4.95 (9)	5.30 (11_	6.46 (13)
Maximum 1/2 hr. Rainfall (mm)	7.5	6.8	8.0	7.7	13.9	34.5	21.1	20.1	16.1	17.3	10.5	10.4
Solar Radiation (mj/m^2)	3	6	12	17	20	22	21	17	11	7	3	2
Relative Humidity (%)	80	79	77	67	57	62	66	69	73	71	80	81

Ten Year Frequency of 1/2 Hour Rainfall - 23 mm.
Ten Year Frequency of 6 Hour Rainfall - 34 mm.
Elevation of Watershed - 669 m.
Latitude of Watershed - 55 degrees 11 sec.

[a] One of the standard deviation entries was incorrect.

[b] Corrected days of rain appear in brackets.

Table B.3c

Soil Pedon[a,b] Breton Loam (Central Gray Luvisolic)

Soil Layer	1	2	3	4	5	6	7
Depth (m)	.01	.11	.15	.36	.61	.76	1.10
Porosity (m/m)	.585	.585	.504	.472	.434	.434	.472
Field capacity (m/m)	.458	.458	.370	.328	.391	.391	.399
Wilting point (m/m)	.309	.309	.236	.188	.319	.310	.280
Bulk density (t/m^3)	1.10	1.10	1.30	1.40	1.50	1.50	1.40
BD - oven dry (t/m^3)	1.10	1.10	1.30	1.40	1.50	1.50	1.40
Sand content (%)	17.0	17.0	18.0	12.0	4.0	2.0	2.0
Silt content (%)	43.0	43.0	43.0	58.0	25.0	33.0	48.0
Clay content (%)	40.0	40.0	39.0	30.0	71.0	65.0	50.0
Soil PH	6.2	6.2	5.8	5.1	4.7	5.0	6.9
Sum of bases (cm01/kg)	0.0	0.0	0.0	0.0	44.0	34.0	6.9
Cation exchange capacity (cm01/kg)	45.0	45.0	23.0	26.0	44.0	34.0	6.9
Calcium carbonate (%)	0.0	0.0	0.0	0.0	4.0	5.0	0.0
Labile phosphorus concentration (g/t)	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrate concentration (g/t)	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Organic nitrogen concentration-active	240	240	32	32	16	16	16
Organic nitrogen-sterile (g/t)	960	960	368	368	184	184	184
Organic carbon (%)	5.99	5.99	1.40	.80	.70	.50	.00
Crop residue (t/ha)	1.00	3.68	.99	.63	.06	.01	.00

Soil albedo = .13.
Maximum number of soil layers = 7
Minimum thickness for layer splitting = .10 m.
Minimum soil profile thickness = .10 m.
Minimum water table depth = 50 m.
Maximum water table depth = 100 m.
Initial water table depth = 75 m.

[a] Some data were incomplete and have been estimated.

[b] Several soil characteristics are estimated by EPIC and have not been included among those listed here.

Table B.4
EPIC Summary Tables

Region	EPIC Run(s)	Average Returns Per Acre ($)	50-Year Erosion (mm)
South	With WGTA[a]	87.08	30.3
	Without WGTA	90.32	23.3
	Without CWB Quotas	84.70	30.1
	Without WGSA	89.45	30.5
	Without Fuel Rebate	88.28	29.8
Central Black	WIth WGTA	108.42	20.4
	Without WGTA	110.41	18.4
	Without CWB Quotas	111.20	20.2
	Without WGSA	105.19	20.6
	Without Fuel Rebate	109.32	14.4
Central Gray	With WGTA	73.21	26.1
	Without WGTA	72.63	25.6
	Without CWB Quotas	77.21	27.0
	Without WGSA	71.08	26.0
	Without Fuel Rebate	73.16	24.7
Peace River	With WGTA	67.52	31.3
	Without WGTA	68.63	30.1
	Without CWB Quotas	68.18	28.7
	Without WGSA	66.24	30.6
	Without Fuel Rebate	68.24	26.6

[a] Current situation (existing WGTA, WGSA, Quotas, etc.)

Table B.5

Crop Rotations Employed to Simulate Recent and Post-WGTA Land Use Patterns, Alberta, By Regions

SOUTH REGION

Recent Pattern: Rotations	Prop. of Land Use	Post-WGTA Pattern: Rotations	Prop. of Land Use
WWF	0.4	WWF	0.5
WBF	0.4	WCBB	0.3
WCBB	0.2	WBBForFor	0.2

Land Use Proportions:	Wheat	Canola	Barley	Forage	Fallow
Recent					
Simulated Rotation	0.45	0.05	0.23	0	0.27
Land Use (actual)	0.42	0.05	0.19	0.07	0.27
Without WGTA					
Simulated Rotation	0.45	0.08	0.23	0.08	0.17
Land Use (Est.)	0.43	0.06	0.23	0.07	0.20

CENTRAL BLACK SOIL REGION

Recent Pattern: Rotations	Prop. of Land Use	Post-WGTA Pattern: Rotations	Prop. of Land Use
WBF	0.4	WBF	0.3
WCBB	0.3	WCBB	0.3
CBBForFor	0.3	CBBForFor	0.4

Land Use Proportions:	Wheat	Canola	Barley	Forage	Fallow
Recent					
Simulated Rotation	0.21	0.14	0.40	0.12	0.13
Land Use (actual)	0.20	0.14	0.38	0.15	0.12
Without WGTA					
Simulated Rotation	0.17	0.16	0.41	0.16	0.10
Land Use (Est.)	0.17	0.16	0.37	0.17	0.12

CENTRAL GRAY SOIL REGION

Recent Pattern: Rotations	Prop. of Land Use	Post-WGTA Pattern: Rotations	Prop. of Land Use
WBBF	0.3	WBBF	0.2
WBForFor	0.3	WBForFor	0.4
CBForFor	0.4	CBForFor	0.4

... continued

Table 5 continued ...

Land Use Proportions:	Wheat	Canola	Barley	Forage	Fallow
Recent					
Simulated Rotation	0.15	0.10	0.33	0.35	0.08
Land Use (acutal)	0.06	0.08	0.40	0.35	0.11
Without WGTA					
Simulated Rotation	0.15	0.10	0.30	0.40	0.05
Land Use (Est.)	0.04	0.08	0.38	0.39	0.11

PEACE RIVER REGION

Recent Pattern: Rotations	Prop. of Land Use	Post-WGTA Pattern: Rotations	Prop. of Land Use
WBF	0.5	WBF	0.4
CBBF	0.2	CBBF	0.2
CBForFor	0.3	CBForFor	0.4

Land Use Proportions:	Wheat	Canola	Barley	Forage	Fallow
Recent					
Simulated Rotation	0.17	0.13	0.34	0.15	0.22
Land Use (actual)	0.20	0.18	0.26	0.16	0.20
Without WGTA					
Simulated Rotation	0.13	0.15	0.33	0.20	0.18
Land Use (Est.)	0.19	0.21	0.27	0.16	0.17

Notes: W wheat
B barley
C canola
F fallow
For forage crop

Source: Cenus, questionnaire and study data.

Table 5 continued ...

Land Use Proportions:					
Recent	Wheat	Canola	Barley	Forage	Fallow
Simulated Rotation	0.15	0.10	0.33	0.35	0.08
Land Use (acutal)	0.06	0.08	0.40	0.35	0.11
Without WGTA					
Simulated Rotation	0.15	0.10	0.30	0.40	0.05
Land Use (Est.)	0.04	0.08	0.38	0.39	0.11

PEACE RIVER REGION

Recent Pattern: Rotations	Prop. of Land Use	Post-WGTA Pattern: Rotations	Prop. of Land Use
WBF	0.5	WBF	0.4
CBBF	0.2	CBBF	0.2
CBForFor	0.3	CBForFor	0.4

Land Use Proportions:					
Recent	Wheat	Canola	Barley	Forage	Fallow
Simulated Rotation	0.17	0.13	0.34	0.15	0.22
Land Use (actual)	0.20	0.18	0.26	0.16	0.20
Without WGTA					
Simulated Rotation	0.13	0.15	0.33	0.20	0.18
Land Use (Est.)	0.19	0.21	0.27	0.16	0.17

Notes:
W wheat
B barley
C canola
F fallow
For forage crop

Source: Cenus, questionnaire and study data.

Table B.6. Continued ...

CENTRAL ALBERTA (Black): (Using Camrose, Alberta Black Soil Data)

Rotations With WGTA	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		30%			30%		
Yield (bu/ac)	44.71	47.4	39.49	30.01	50.29	37.43	47.02	1.46
50-Year Erosion for Rotation (mm)	32.8		11.1			13		
Av. Annual Gross Receipts/Acre	$88.36		$135.67			$107.93		

Rotations Without WGTA	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	WBB ForFor Canola	Barley	Forage
% Area in Rotation	30%		30%			40%		
Yield (bu/ac)	44.67	47.22	39.48	30	50.28	37.26	46.92	1.46
50-Year Erosion for Rotation (mm)	32.8		11.1			13		
Av. Annual Gross Receipts/Acre	$88.80		$135.66			$107.69		

Results Weighted by Rotation:

With WGTA		Without WGTA	
Wheat Yield (bu/ac)	42.47	Wheat Yield (bu/ac)	42.08
Canola Yield (bu/ac)	33.72	Canola Yield (bu/ac)	34.15
Barley Yield (bu/ac)	48.15	Barley Yield (bu/ac)	48.02
		Forage Yield (T/ac)	1.46
50-Year Erosion (mm)	20.35	50-Year Erosion (mm)	18.4
Av. Annual Gross Receipts/Acre	$108.42	Av. Annual Gross Receipts/Acre	$110.41

... continued

Table B.6. Continued ...

CENTRAL ALBERTA (Gray): (Using Edmonton weather, Breton Gray Soil Data)

Rotations With WGTA	WBBF Wheat	Barley	WB ForFor Wheat	Barley	Forage	CBB ForFor Canola	Barley	Forage
% Area in Rotation	30%		30%			40%		
Yield (bu/ac)	35.12	35.66	33.93	36.05	0.9	25.92	38.18	0.91
50-Year Erosion for Rotation (mm)	28.8		24.4			25.3		
Av. Annual Gross Receipts/Acre	$68.80		$68.48			$80.07		

Rotations Without WGTA	WBBF Wheat	Barley	WB ForFor Wheat	Barley	Forage	CBB ForFor Canola	Barley	Forage
% Area in Rotation	20%		40%			40%		
Yield (bu/ac)	34.99	34.99	33.72	35.63	0.89	25.67	38.01	0.91
50-Year Erosion for Rotation (mm)	28.9		24.3			25.3		
Av. Annual Gross Receipts/Acre	$68.03		$68.02			$79.55		

Results Weighted by Rotation:

With WGTA		Without WGTA	
Wheat Yield (bu/ac)	34.53	Wheat Yield (bu/ac)	34.14
Canola Yield (bu/ac)	30.26	Canola Yield (bu/ac)	30.65
Barley Yield (bu/ac)	26.24	Barley Yield (bu/ac)	22.56
		Forage Yield (T/ac)	0.91
50-Year Erosion (mm)	26.1	50-Year Erosion (mm)	25.6
Av. Annual Gross Receipts/Acre	$73.21	Av. Annual Gross Receipts/Acre	$72.63

... continued

Table B.6. Continued ...

PEACE RIVER: (Using Peace River weather; Breton Gray Soil Data)

Rotations With WGTA	WBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	30.59	32.07	26.17	32.88	24.26	33.02	0.88
50-Year Erosion for Rotation (mm)	35.2		32.4		24.2		
Av. Annual Gross Receipts/Acre	$60.22		$75.72		$74.23		

Rotations Without WGTA	WBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		20%		40%		
Yield (bu/ac)	30.56	31.58	26.07	32.75	24.09	32.9	0.88
50-Year Erosion for Rotation (mm)	35		32.3		24.2		
Av. Annual Gross Receipts/Acre	$60.05		$75.42		$73.83		

Results Weighted by Rotation:

With WGTA		Without WGTA	
Wheat Yield (bu/ac)	30.59	Wheat Yield (bu/ac)	30.56
Canola Yield (bu/ac)	25.02	Canola Yield (bu/ac)	24.75
Barley Yield (bu/ac)	32.52	Barley Yield (bu/ac)	32.45
		Forage Yield (T/ac)	0.88
50-Year Erosion (mm)	31.3	50-Year Erosion (mm)	30.1
Av. Annual Gross Receipts/Acre	$67.52	Av. Annual Gross Receipts/Acre	$68.63

Table B.7

Illustrative Effects of Soil Erosion in Alberta With and Without CWB Quotas, 50-Year Simulation Using Erosion Productivity Impact Calculator (EPIC)

SOUTHERN ALBERTA: (Using Warner, Alberta Soil Data)

Rotations With CWB Quotas	WWF Wheat	WBF Wheat	Barley	WCBB Wheat	Canola	Barley
% Area in Rotation	40%	40%		20%		
Yield (bu/ac)	33.91	40.22	34.49	32.41	26.32	40.45
50-Year Erosion for Rotation (mm)	35.3	35.3		10.2		
Av. Annual Gross Receipts/Acre	$86.85	$74.14		$113.44		

Rotations Without CWB Quotas	WWF Wheat	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	Forage
% Area in Rotation	60%	20%		20%			
Yield (bu/ac)	33.91	40.22	34.49	32.41	26.32	40.45	0.92
50-Year Erosion for Rotation (mm)	35.3	35.3		10.2			
Av. Annual Gross Receipts/Acre	$89.85	$74.14		$113.44			

Results Weighted by Rotation:

With CWB Quotas		Without CWB Quotas	
Wheat Yield (bu/ac)	36.13	Wheat Yield (bu/ac)	36.13
Canola Yield (bu/ac)	26.32	Canola Yield (bu/ac)	26.32
Barley Yield (bu/ac)	36.48	Barley Yield (bu/ac)	36.48
50-Year Erosion (mm)	30.28	50-Year Erosion (mm)	30.28
Av. Annual Gross Receipts/Acre	$87.08	Av. Annual Gross Receipts/Acre	$88.28

... continued

Table B.7. Continued ...

CENTRAL ALBERTA (Black): (Using Camrose, Alberta Black Soil Data)

Rotations With CWB Quotas	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		30%			30%		
Yield (bu/ac)	44.71	47.4	39.49	30.01	50.29	37.43	47.02	1.46
50-Year Erosion for Rotation (mm)	32.8		11.1			13		
Av. Annual Gross Receipts/Acre	$88.36		$135.67			$107.93		

Rotations Without CWB Quotas	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	WBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		40%			20%		
Yield (bu/ac)	44.71	47.4	39.49	30.01	50.29	37.43	47.02	1.46
50-Year Erosion for Rotation (mm)	32.8		11.1			13		
Av. Annual Gross Receipts/Acre	$88.36		$135.67			$107.93		

Results Weighted by Rotation:

With CWB Quotas		Without CWB Quotas	
Wheat Yield (bu/ac)	42.47	Wheat Yield (bu/ac)	42.10
Canola Yield (bu/ac)	33.72	Canola Yield (bu/ac)	32.48
Barley Yield (bu/ac)	48.15	Barley Yield (bu/ac)	48.48
		Forage Yield (T/ac)	1.46
50-Year Erosion (mm)	20.35	50-Year Erosion (mm)	20.16
Av. Annual Gross Receipts/Acre	$108.42	Av. Annual Gross Receipts/Acre	$111.20

... continued

Table B.7. Continued ...

CENTRAL ALBERTA (Gray): (Using Edmonton weather, Breton Gray Soil Data)

Rotations With CWB Quotas	WBBF Wheat	Barley	WB ForFor Wheat	Barley	Forage	CBB ForFor Canola	Barley	Forage
% Area in Rotation	30%		30%			40%		
Yield (bu/ac)	35.12	35.66	33.93	36.05	0.9	25.92	38.18	0.91
50-Year Erosion for Rotation (mm)	28.8		24.4			25.3		
Av. Annual Gross Receipts/Acre	$68.80		$68.49			$80.06		

Rotations Without CWB Quotas	WBBF Wheat	Barley	WB ForFor Wheat	Barley	Forage	CBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		40%			20%		
Yield (bu/ac)	28.85	37.35	33.93	36.05	0.9	25.92	38.18	0.91
50-Year Erosion for Rotation (mm)	30.5		24.3			25.3		
Av. Annual Gross Receipts/Acre	$84.51		$68.49			$80.06		

Results Weighted by Rotation:

With CWB Quotas		Without CWB Quotas	
Wheat Yield (bu/ac)	34.53	Wheat Yield (bu/ac)	31.39
Canola Yield (bu/ac)	30.26	Canola Yield (bu/ac)	32.67
Barley Yield (bu/ac)	26.24	Barley Yield (bu/ac)	22.94
		Forage Yield (T/ac)	0.91
50-Year Erosion (mm)	26.1	50-Year Erosion (mm)	27.0
Av. Annual Gross Receipts/Acre	$73.21	Av. Annual Gross Receipts/Acre	$77.21

... continued

Table B.7. Continued ...

PEACE RIVER: (Using Peace River weather; Breton Gray Soil Data)

Rotations With CWB Quotas	WBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	30.59	32.07	26.17	32.88	24.26	33.02	0.88
50-Year Erosion for Rotation (mm)	35.2		32.4		24.2		
Av. Annual Gross Receipts/Acre	$59.94		$75.77		$74.53		

Rotations Without CWB Quotas	WBBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	31.16	31.95	26.12	33.03	24.44	33.29	0.94
50-Year Erosion for Rotation (mm)	30.2		31.8		24.1		
Av. Annual Gross Receipts/Acre	$61.34		$75.77		$74.53		

Results Weighted by Rotation:

With CWB Quotas		Without CWB Quotas	
Wheat Yield (bu/ac)	30.59	Wheat Yield (bu/ac)	31.16
Canola Yield (bu/ac)	25.02	Canola Yield (bu/ac)	25.11
Barley Yield (bu/ac)	32.52	Barley Yield (bu/ac)	32.57
		Forage Yield (T/ac)	0.94
50-Year Erosion (mm)	31.3	50-Year Erosion (mm)	28.7
Av. Annual Gross Receipts/Acre	$67.52	Av. Annual Gross Receipts/Acre	$68.18

Table B.7. Continued ...

CENTRAL ALBERTA (Gray): (Using Edmonton weather, Breton Gray Soil Data)

Rotations With CWB Quotas	WBBF Wheat	Barley	WB ForFor Wheat	Barley	Forage	CBB ForFor Canola	Barley	Forage
% Area in Rotation	30%		30%			40%		
Yield (bu/ac)	35.12	35.66	33.93	36.05	0.9	25.92	38.18	0.91
50-Year Erosion for Rotation (mm)	28.8		24.4			25.3		
Av. Annual Gross Receipts/Acre	$68.80		$68.49			$80.06		

Rotations Without CWB Quotas	WBBF Wheat	Barley	WB ForFor Wheat	Barley	Forage	CBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		40%			20%		
Yield (bu/ac)	28.85	37.35	33.93	36.05	0.9	25.92	38.18	0.91
50-Year Erosion for Rotation (mm)	30.5		24.3			25.3		
Av. Annual Gross Receipts/Acre	$84.51		$68.49			$80.06		

Results Weighted by Rotation:

With CWB Quotas		Without CWB Quotas	
Wheat Yield (bu/ac)	34.53	Wheat Yield (bu/ac)	31.39
Canola Yield (bu/ac)	30.26	Canola Yield (bu/ac)	32.67
Barley Yield (bu/ac)	26.24	Barley Yield (bu/ac)	22.94
		Forage Yield (T/ac)	0.91
50-Year Erosion (mm)	26.1	50-Year Erosion (mm)	27.0
Av. Annual Gross Receipts/Acre	$73.21	Av. Annual Gross Receipts/Acre	$77.21

... continued

Table B.7. Continued ...

PEACE RIVER: (Using Peace River weather; Breton Gray Soil Data)

Rotations With CWB Quotas	WBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	30.59	32.07	26.17	32.88	24.26	33.02	0.88
50-Year Erosion for Rotation (mm)	35.2		32.4		24.2		
Av. Annual Gross Receipts/Acre	$59.94		$75.77		$74.53		

Rotations Without CWB Quotas	WBBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	31.16	31.95	26.12	33.03	24.44	33.29	0.94
50-Year Erosion for Rotation (mm)	30.2		31.8		24.1		
Av. Annual Gross Receipts/Acre	$61.34		$75.77		$74.53		

Results Weighted by Rotation:

With CWB Quotas		Without CWB Quotas	
Wheat Yield (bu/ac)	30.59	Wheat Yield (bu/ac)	31.16
Canola Yield (bu/ac)	25.02	Canola Yield (bu/ac)	25.11
Barley Yield (bu/ac)	32.52	Barley Yield (bu/ac)	32.57
		Forage Yield (T/ac)	0.94
50-Year Erosion (mm)	31.3	50-Year Erosion (mm)	28.7
Av. Annual Gross Receipts/Acre	$67.52	Av. Annual Gross Receipts/Acre	$68.18

Table B.8

Illustrative Effects of Soil Erosion in Alberta With and Without WGSA, 50-Year Simulation Using Erosion Productivity Impact Calculator (EPIC)

SOUTHERN ALBERTA: (Using Warner, Alberta Soil Data)

Rotations Existing	WWF Wheat	WBF Wheat	Barley	WCBB Wheat	Canola	Barley
% Area in Rotation	40%	40%		20%		
Yield (bu/ac)	33.91	40.22	34.49	32.41	26.32	40.45
50-Year Erosion for Rotation (mm)	35.3	35.3		10.2		
Av. Annual Gross Receipts/Acre	$86.84	$74.14		$113.44		

Rotations With 10% More Inputs	WWF Wheat	WBF Wheat	Barley	WCBB Wheat	Canola	Barley
% Area in Rotation	40%	40%		20%		
Yield (bu/ac)	34.91	41.13	35.89	33.98	26.47	41.28
50-Year Erosion for Rotation (mm)	35.3	35.3		10.2		
Av. Annual Gross Receipts/Acre	$89.41	$76.22		$116.00		

Results Weighted by Rotation:

Existing		With 10% More Inputs	
Wheat Yield (bu/ac)	36.13	Wheat Yield (bu/ac)	37.21
Canola Yield (bu/ac)	26.32	Canola Yield (bu/ac)	26.47
Barley Yield (bu/ac)	36.48	Barley Yield (bu/ac)	37.69
50-Year Erosion (mm)	30.3	50-Year Erosion (mm)	30.5
Av. Annual Gross Receipts/Acre	$87.08	Av. Annual Gross Receipts/Acre	$89.45

... continued

Table B.8. Continued ...

CENTRAL ALBERTA (Black): (Using Camrose, Alberta Black Soil Data)

Rotations Existing	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		30%			30%		
Yield (bu/ac)	44.71	47.4	39.49	30.01	50.29	37.43	47.02	1.46
50-Year Erosion for Rotation (mm)	32.8		11.1			13		
Av. Annual Gross Receipts/Acre	$88.36		$135.67			$107.93		

Rotations With 10% More Inputs	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	WBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		40%			20%		
Yield (bu/ac)	44.74	48.25	39.49	30.01	50.29	37.79	47.26	1.48
50-Year Erosion for Rotation (mm)	32.9		11.1			13		
Av. Annual Gross Receipts/Acre	$88.95		$135.68			$108.95		

Results Weighted by Rotation:

Existing		With 10% More Inputs	
Wheat Yield (bu/ac)	42.47	Wheat Yield (bu/ac)	42.12
Canola Yield (bu/ac)	33.72	Canola Yield (bu/ac)	32.60
Barley Yield (bu/ac)	48.15	Barley Yield (bu/ac)	48.87
		Forage Yield (T/ac)	1.48
50-Year Erosion (mm)	20.3	50-Year Erosion (mm)	20.2
Av. Annual Gross Receipts/Acre	$108.42	Av. Annual Gross Receipts/Acre	$111.65

... continued

Table B.8 Continued ...

CENTRAL ALBERTA (Gray): (Using Edmonton weather, Breton Gray Soil Data)

Rotations Existing	WBBF Wheat	Barley	WB ForFor Wheat	Barley	Forage	CBB ForFor Canola	Barley	Forage
% Area in Rotation	30%		30%			40%		
Yield (bu/ac)	35.12	35.66	33.93	36.05	0.9	25.92	38.18	0.91
50-Year Erosion for Rotation (mm)	28.8		24.4			25.3		
Av. Annual Gross Receipts/Acre	$68.80		$68.48			$80.07		

Rotations With 10% More Inputs	WBBF Wheat	Barley	WB ForFor Wheat	Barley	Forage	CBB ForFor Canola	Barley	Forage
% Area in Rotation	30%		30%			40%		
Yield (bu/ac)	35.49	36.96	35.07	37.09	0.9	27.37	38.63	0.91
50-Year Erosion for Rotation (mm)	28.8		24.6			25.5		
Av. Annual Gross Receipts/Acre	$70.42		$70.23			$82.87		

Results Weighted by Rotation:

Existing		With 10% More Inputs	
Wheat Yield (bu/ac)	34.53	Wheat Yield (bu/ac)	35.28
Canola Yield (bu/ac)	30.26	Canola Yield (bu/ac)	31.54
Barley Yield (bu/ac)	26.24	Barley Yield (bu/ac)	26.81
		Forage Yield (T/ac)	0.91
50-Year Erosion (mm)	26.1	50-Year Erosion (mm)	26.2
Av. Annual Gross Receipts/Acre	$73.21	Av. Annual Gross Receipts/Acre	$75.34

... continued

Table B.8. Continued ...

PEACE RIVER: (Using Peace River weather; Breton Gray Soil Data)

Rotations Existing	WBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	30.59	32.07	26.17	32.88	24.26	33.02	0.88
50-Year Erosion for Rotation (mm)	35.2		34.2		24.2		
Av. Annual Gross Receipts/Acre	$60.22		$75.72		$74.23		

Rotations Without CWB Quotas	WBBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	30.99	32.38	26.53	33.29	25.45	33.43	0.89
50-Year Erosion for Rotation (mm)	36.2		32.8		24.3		
Av. Annual Gross Receipts/Acre	$60.93		$76.71		$76.58		

Results Weighted by Rotation:

Existing		With 10% More Inputs	
Wheat Yield (bu/ac)	30.59	Wheat Yield (bu/ac)	30.99
Canola Yield (bu/ac)	25.02	Canola Yield (bu/ac)	25.88
Barley Yield (bu/ac)	32.52	Barley Yield (bu/ac)	32.88
		Forage Yield (T/ac)	0.89
50-Year Erosion (mm)	31.3	50-Year Erosion (mm)	32.0
Av. Annual Gross Receipts/Acre	$67.52	Av. Annual Gross Receipts/Acre	$68.78

Table B.9
Illustrative Effects of Soil Erosion in Alberta With and Without Farm Fuel Rebates, 50-Year Simulation Using Erosion Productivity Impact Calculator (EPIC)

SOUTHERN ALBERTA: (Using Warner, Alberta Soil Data)

Rotations With Fuel Rebates	WWF Wheat	WBF Wheat	Barley	WCBB Wheat	Canola	Barley
% Area in Rotation	40%	40%		20%		
Yield (bu/ac)	33.91	40.22	34.49	32.41	26.32	40.45
50-Year Erosion for Rotation (mm)	35.3	35.3		10.2		
Av. Annual Gross Receipts/Acre	$86.84	$74.14		$113.44		

Rotations Without Fuel Rebates	WWF Wheat	WBF Wheat	Barley	WCBB Wheat	Canola	Barley
% Area in Rotation	40%	40%		20%		
Yield (bu/ac)	33.98	40.23	34.66	32.58	26.14	40.38
50-Year Erosion for Rotation (mm)	34.6	34.7		10.2		
Av. Annual Gross Receipts/Acre	$87.03	$74.25		$113.24		

Results Weighted by Rotation:

With Fuel Rebates		Without Fuel Rebates	
Wheat Yield (bu/ac)	36.13	Wheat Yield (bu/ac)	36.20
Canola Yield (bu/ac)	26.32	Canola Yield (bu/ac)	26.14
Barley Yield (bu/ac)	36.48	Barley Yield (bu/ac)	36.57
50-Year Erosion (mm)	30.3	50-Year Erosion (mm)	29.8
Av. Annual Gross Receipts/Acre	$87.08	Av. Annual Gross Receipts/Acre	$88.44

... continued

Table B.9. Continued ...

CENTRAL ALBERTA (Black): (Using Camrose, Alberta Black Soil Data)

Rotations With Fuel Rebates	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		30%			30%		
Yield (bu/ac)	44.71	47.4	39.49	30.01	50.29	37.43	47.02	1.46
50-Year Erosion for Rotation (mm)	32.8		11.1			13		
Av. Annual Gross Receipts/Acre	$88.36		$135.67			$107.93		

Rotations Without Fuel Rebates	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	WBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		30%			30%		
Yield (bu/ac)	44.33	47.22	40.39	30.64	51.36	37.57	46.92	1.35
50-Year Erosion for Rotation (mm)	20.9		8.7			11.4		
Av. Annual Gross Receipts/Acre	$89.12		$138.63			$106.95		

Results Weighted by Rotation:

With Fuel Rebates		Without Fuel Rebates	
Wheat Yield (bu/ac)	42.47	Wheat Yield (bu/ac)	43.21
Canola Yield (bu/ac)	33.72	Canola Yield (bu/ac)	34.11
Barley Yield (bu/ac)	48.15	Barley Yield (bu/ac)	48.37
		Forage Yield (T/ac)	1.35
50-Year Erosion (mm)	20.35	50-Year Erosion (mm)	14.4
Av. Annual Gross Receipts/Acre	$108.42	Av. Annual Gross Receipts/Acre	$109.32

... continued

Table B.9. Continued ...

CENTRAL ALBERTA (Black): (Using Camrose, Alberta Black Soil Data)

Rotations With Fuel Rebates	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		30%			30%		
Yield (bu/ac)	44.71	47.4	39.49	30.01	50.29	37.43	47.02	1.46
50-Year Erosion for Rotation (mm)	32.8		11.1			13		
Av. Annual Gross Receipts/Acre	$88.36		$135.67			$107.93		

Rotations Without Fuel Rebates	WBF Wheat	Barley	WCBB Wheat	Canola	Barley	WBB ForFor Canola	Barley	Forage
% Area in Rotation	40%		30%			30%		
Yield (bu/ac)	44.33	47.22	40.39	30.64	51.36	37.57	46.92	1.35
50-Year Erosion for Rotation (mm)	20.9		8.7			11.4		
Av. Annual Gross Receipts/Acre	$89.12		$138.63			$106.95		

Results Weighted by Rotation:

With Fuel Rebates		Without Fuel Rebates	
Wheat Yield (bu/ac)	42.47	Wheat Yield (bu/ac)	43.21
Canola Yield (bu/ac)	33.72	Canola Yield (bu/ac)	34.11
Barley Yield (bu/ac)	48.15	Barley Yield (bu/ac)	48.37
		Forage Yield (T/ac)	1.35
50-Year Erosion (mm)	20.35	50-Year Erosion (mm)	14.4
Av. Annual Gross Receipts/Acre	$108.42	Av. Annual Gross Receipts/Acre	$109.32

... continued

Table B.9. Continued ...

PEACE RIVER: (Using Peace River weather; Breton Gray Soil Data)

Rotations With Fuel Rebates	WBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	30.59	32.07	26.17	32.88	24.26	33.02	0.88
50-Year Erosion for Rotation (mm)	35.2		32.4		24.2		
Av. Annual Gross Receipts/Acre	$60.22		$75.72		$74.23		

Rotations Without Fuel Rebates	WBBF Wheat	Barley	CBBF Canola	Barley	CBB ForFor Canola	Barley	Forage
% Area in Rotation	50%		20%		30%		
Yield (bu/ac)	31.17	32.67	26.32	33.11	24.45	33.23	0.87
50-Year Erosion for Rotation (mm)	28.7		26.6		23.0		
Av. Annual Gross Receipts/Acre	$61.36		$76.17		$74.43		

Results Weighted by Rotation:

With Fuel Rebates		Without Fuel Rebates	
Wheat Yield (bu/ac)	30.59	Wheat Yield (bu/ac)	31.17
Canola Yield (bu/ac)	25.02	Canola Yield (bu/ac)	25.20
Barley Yield (bu/ac)	32.52	Barley Yield (bu/ac)	32.93
		Forage Yield (T/ac)	0.87
50-Year Erosion (mm)	31.3	50-Year Erosion (mm)	26.6
Av. Annual Gross Receipts/Acre	$67.52	Av. Annual Gross Receipts/Acre	$68.24

Table B.10

Summary of Simulated 50-Year Erosion Estimates and Gross Receipts Per Acre During 50-Year Simulation, by Alberta Regional Selected Programs

Region	With WGTA: 50-Year Erosion (mm)	With WGTA: Average Annual Gross Receipts Per Acre	Without WGTA: 50-Year Erosion (mm)	Without WGTA: Average Annual Gross Receipts Per Acre
Southern Alberta	30.3	$87.08	23.3	$90.32
Central Alberta (Black Soil)	20.4	$108.42	18.4	$110.41
Central Alberta (Gray Soil)	26.1	$73.21	25.6	$72.63
Peace River (Gray Soil)	31.3	$67.52	30.1	$68.63

Region	With CWB Quotas: 50-Year Erosion (mm)	With CWB Quotas: Average Annual Gross Receipts Per Acre	Without CWB Quotas: 50-Year Erosion (mm)	Without CWB Quotas: Average Annual Gross Receipts Per Acre
Southern Alberta	30.3	$87.08	30.3	$88.28
Central Alberta (Black Soil)	20.4	$108.42	20.3	$110.20
Central Alberta (Gray Soil)	26.1	$73.21	27.0	$77.21
Peace River (Gray Soil)	31.3	$67.52	28.7	$68.18

Region	With WGSA: 50-Year Erosion (mm)	With WGSA: Average Annual Gross Receipts Per Acre	Without WGSA: 50-Year Erosion (mm)[a]	Without WGSA: Average Annual Gross Receipts Per Acre[a]
Southern Alberta	30.3	$87.08	30.1	$84.70
Central Alberta (Black Soil)	20.4	$108.42	20.6	$105.19
Central Alberta (Gray Soil)	26.1	$73.21	26.0	$71.08
Peace River (Gray Soil)	31.3	$67.52	30.6	$66.24

Region	With Farm Fuel Rebates: 50-Year Erosion (mm)	With Farm Fuel Rebates: Average Annual Gross Receipts Per Acre	Without Farm Fuel Rebates: 50-Year Erosion (mm)	Without Farm Fuel Rebates: Average Annual Gross Receipts Per Acre
Southern Alberta	30.3	$87.08	29.8	$88.28
Central Alberta (Black Soil)	20.4	$108.42	14.4	$109.32
Central Alberta (Gray Soil)	26.1	$73.21	24.7	$73.16
Peace River (Gray Soil)	31.3	$67.52	26.6	$68.24

[a] Inferred from simulations of increased input use.

Source: Study simulations. Estimates of average annual gross receipts per acre reflect assumed rotations and yields, priced at late 1980's levels. There is no significant trend in yields during the 50 years in any of the above simulations.

Table B.11

Comparative 50-Year Erosion Rates Using Study Grey Wooded Soil and Alternative Gray Wooded Soil, Peace River Area of Alberta

Rotation	50-Year Erosion from Study Soil (Breton Gray Wooded)[a] (mm)	50-Year Erosion from Peace Area Soil (Gray Wooded)[b] (mm)
Basic Rotations		
WBF	35.2	37.5
CBBF	32.4	34.8
CBBFor	24.2	25.5
Post-WGTA		
WBF	35.0	37.5
CBBF	32.4	34.9
CBBFor	24.2	25.5
Post-Farm Fuel Rebates		
CBBF	26.6	30.1
CBBForFor	23.0	25.0

W - wheat; B - barley; C - canola; For - forage.

[a] Study data using Peace Area Weather, gray wooded soil from outside of Peace River region.

[b] Data from areas made after study data, using Peace River region weather and typical gray luvisolic soil from Peace region.

Source: Study EPIC simulations.

Table B.10

Summary of Simulated 50-Year Erosion Estimates and Gross Receipts Per Acre During 50-Year Simulation, by Alberta Regional Selected Programs

Region	With WGTA: 50-Year Erosion (mm)	With WGTA: Average Annual Gross Receipts Per Acre	Without WGTA: 50-Year Erosion (mm)	Without WGTA: Average Annual Gross Receipts Per Acre
Southern Alberta	30.3	$87.08	23.3	$90.32
Central Alberta (Black Soil)	20.4	$108.42	18.4	$110.41
Central Alberta (Gray Soil)	26.1	$73.21	25.6	$72.63
Peace River (Gray Soil)	31.3	$67.52	30.1	$68.63

Region	With CWB Quotas: 50-Year Erosion (mm)	With CWB Quotas: Average Annual Gross Receipts Per Acre	Without CWB Quotas: 50-Year Erosion (mm)	Without CWB Quotas: Average Annual Gross Receipts Per Acre
Southern Alberta	30.3	$87.08	30.3	$88.28
Central Alberta (Black Soil)	20.4	$108.42	20.3	$110.20
Central Alberta (Gray Soil)	26.1	$73.21	27.0	$77.21
Peace River (Gray Soil)	31.3	$67.52	28.7	$68.18

Region	With WGSA: 50-Year Erosion (mm)	With WGSA: Average Annual Gross Receipts Per Acre	Without WGSA: 50-Year Erosion (mm)[a]	Without WGSA: Average Annual Gross Receipts Per Acre[a]
Southern Alberta	30.3	$87.08	30.1	$84.70
Central Alberta (Black Soil)	20.4	$108.42	20.6	$105.19
Central Alberta (Gray Soil)	26.1	$73.21	26.0	$71.08
Peace River (Gray Soil)	31.3	$67.52	30.6	$66.24

Region	With Farm Fuel Rebates: 50-Year Erosion (mm)	With Farm Fuel Rebates: Average Annual Gross Receipts Per Acre	Without Farm Fuel Rebates: 50-Year Erosion (mm)	Without Farm Fuel Rebates: Average Annual Gross Receipts Per Acre
Southern Alberta	30.3	$87.08	29.8	$88.28
Central Alberta (Black Soil)	20.4	$108.42	14.4	$109.32
Central Alberta (Gray Soil)	26.1	$73.21	24.7	$73.16
Peace River (Gray Soil)	31.3	$67.52	26.6	$68.24

[a] Inferred from simulations of increased input use.

Source: Study simulations. Estimates of average annual gross receipts per acre reflect assumed rotations and yields, priced at late 1980's levels. There is no significant trend in yields during the 50 years in any of the above simulations.

Table B.11

Comparative 50-Year Erosion Rates Using Study Grey Wooded Soil and Alternative Gray Wooded Soil, Peace River Area of Alberta

Rotation	50-Year Erosion from Study Soil (Breton Gray Wooded)[a] (mm)	50-Year Erosion from Peace Area Soil (Gray Wooded)[b] (mm)
Basic Rotations		
WBF	35.2	37.5
CBBF	32.4	34.8
CBBFor	24.2	25.5
Post-WGTA		
WBF	35.0	37.5
CBBF	32.4	34.9
CBBFor	24.2	25.5
Post-Farm Fuel Rebates		
CBBF	26.6	30.1
CBBForFor	23.0	25.0

W - wheat; B - barley; C - canola; For - forage.

[a] Study data using Peace Area Weather, gray wooded soil from outside of Peace River region.

[b] Data from areas made after study data, using Peace River region weather and typical gray luvisolic soil from Peace region.

Source: Study EPIC simulations.

APPENDIX C - QUESTIONNAIRE

SOIL CONSERVATION PRACTICES AND SELECTED FARM PROGRAMS

SECTION I

GENERAL INFORMATION ABOUT SOIL QUALITY IN YOUR AREA

Please provide some general information about the location of your farm and the changes in soil quality (erosion, salinity, amount of organic matter) in your community during the 1980s.

1. Is soil degradation a problem in your community? _____ YES _____ NO _____ NOT SURE
If yes, PLEASE CHECK

	Slight Problem	Moderate Problem	Serious Problem
Wind erosion	_____	_____	_____
Water erosion	_____	_____	_____
Soil salinity	_____	_____	_____
Organic matter loss	_____	_____	_____
Acid soils	_____	_____	_____

2. Is soil degradation a problem on your farm? _____ YES _____ NO _____ NOT SURE
If yes, PLEASE CHECK

	Slight Problem	Moderate Problem	Serious Problem
Wind erosion	_____	_____	_____
Water erosion	_____	_____	_____
Soil salinity	_____	_____	_____
Organic matter loss	_____	_____	_____
Acid soils	_____	_____	_____

3. Has soil degradation become a more serious problem during the last 10 years? PLEASE CHECK.

	In This Community			On My Farm		
	More Serious	No Change	Less Serious	More Serious	No Change	Less Serious
Wind erosion	_____	_____	_____	_____	_____	_____
Water erosion	_____	_____	_____	_____	_____	_____
Soil salinity	_____	_____	_____	_____	_____	_____
Organic matter loss	_____	_____	_____	_____	_____	_____
Acid soils	_____	_____	_____	_____	_____	_____

4. Please tell us generally where your farm is located based on the attached agroecological map of the province:
Agroecological area code: (A1, ..., V3 etc.): ______________________________

SECTION II

EFFECTS OF SPECIFIC POLICIES ON SOIL CONSERVATION PRACTICES

Please tell us about your reaction (if any) to each of the following programs.

Part I. Western Grain Transportation Act (WGTA)

Under the federal government's Western Grain Transportation Act (WGTA), Canadian rail companies receive an annual subsidy (about $720 million per year) to offset part of the cost of shipping grain to export terminals. The payment is made to railways and therefore applies only to export grains. The subsidy is currently about $23 per tonne for grain shipped to export from Alberta.

1. Did this program affect the way you managed your farm, or the crops you grew during the 1980's? Put differently, if costs of shipping grain had been higher, would this have affected your production decisions? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 3 below.

2. If "YES", in what ways did this program affect your farming activities during the 1980's? PLEASE CHECK. (Ignore changes to your total land base through the purchase, sale and/or rental of land).

	INCREASE	NO CHANGE	DECREASE
Cultivated acreage	_____	_____	_____
Summerfallow acreage	_____	_____	_____
Forage acreage	_____	_____	_____
Inputs (e.g. fertilizer, spray) per acre	_____	_____	_____
Tillage operations	_____	_____	_____
Livestock production	_____	_____	_____

3. In general, do you believe the response of farmers to the WGTA has affected the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ____

____

____

Part II. Western Grain Stabilization Act (WGSA)

The Western Grain Stabilization program has been in operation since 1976, and membership has been voluntary. Farmers who belong pay a percentage of their gross sales to the WGSA (currently 4% on up to $60,000 in sales) and the federal government contributes an amount equal to the farmer contribution plus 2 percentage points. Large payouts to contributing farmers were made during several years in the 1980's as a result of the declines in receipts of grain farmers in Western Canada during that time.

1. Do you, or have you in recent years, participated in the Western Grain Stabilization Program (WGSA)? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 4 below.

2. Did this program affect the way you managed your farm, or the crops you grew during the 1980's? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 4 below.

3. If "YES", in what ways did this program affect your farming activities during the 1980's? PLEASE CHECK. (Ignore changes to your total land base through the purchase, sale and/or rental of land).

	INCREASE	NO CHANGE	DECREASE
Cultivated acreage	_____	_____	_____
Summerfallow acreage	_____	_____	_____
Forage acreage	_____	_____	_____
Inputs (e.g. fertilizer, spray) per acre	_____	_____	_____
Tillage operations	_____	_____	_____
Livestock production	_____	_____	_____

4. In general, do you believe the response of farmers to the WGSA has affected the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ____

____

____

Part III. Canadian Wheat Board (CWB) Quota Policy

The Canadian Wheat Board manages the marketing of CWB grains through a quota policy which rations access to the grain handling and transportation system, and attempts to share sales opportunities among farmers. The quota has undergone a number of changes over the years, but continues to be based on the acreage of eligible crops grown by a farmer. Formerly, the quota policy was based entirely on cultivated acreage. Since 1984, the quota delivery opportunity has been higher for farmers who report low levels of summerfallow.

1. Did the CWB delivery quota system affect the way you managed your farm, or the crops you grew during the 1980's? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 3 below.

2. If "YES", in what ways did this program affect your farming activities during the 1980's? PLEASE CHECK. (Ignore changes to your total land base through the purchase, sale and/or rental of land).

	INCREASE	NO CHANGE	DECREASE
Cultivated acreage	_____	_____	_____
Summerfallow acreage	_____	_____	_____
Forage acreage	_____	_____	_____
Inputs (e.g. fertilizer, spray) per acre	_____	_____	_____
Tillage operations	_____	_____	_____
Livestock production	_____	_____	_____

3. In general, do you believe the response of farmers to the CWB delivery quota system has affected the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ____

____

____

Part IV. Farm Fuel Rebates

Farm fuel rebates (both federal and provincial) result in lower prices paid for farm fuels. The size of this saving, as reported by Agriculture Canada for Calgary in August of 1989, is approximately as follows: (cents per litre)

	Retail Price	Less Federal Tax Rebates	Less Provincial Tax Rebates	Approximate Farm Price	Percent Rebate
Diesel	39	7.5	19	12.5	68%
Gasoline	48	10	14	24	50%

1. Did this program affect the way you managed your farm, or the crops you grew during the 1980's? PLEASE CHECK ONE.

   __________ YES

   __________ NO

   If "NO", please go directly to 3 below.

2. If "YES", in what ways did this program affect your farming activities during the 1980's? PLEASE CHECK. (Ignore changes to your total land base through the purchase, sale and/or rental of land).

	INCREASE	NO CHANGE	DECREASE
Cultivated acreage	_____	_____	_____
Summerfallow acreage	_____	_____	_____
Forage acreage	_____	_____	_____
Inputs (e.g. fertilizer, spray) per acre	_____	_____	_____
Tillage operations	_____	_____	_____
Livestock production	_____	_____	_____

3. In general, do you believe the response of farmers to these fuel tax rebates has affected the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ____

____

____

Part V. All-Risk Crop Insurance

Established in 1959, the current program of all-risk crop insurance is jointly funded. To date, the federal government has paid 50 percent of the insurance premiums while the provincial government has paid administrative costs. In addition, the provincial (Alberta) government subsidizes crop insurance premiums for higher-risk areas. Government contributions have kept the farmer's overall share of the insurance premium at less than one-half of what it would otherwise be. All-risk crop insurance uses yields as the basis for making payments. Maximum insurable coverage cannot exceed 80 percent of the long-term area average yield for any single crop. Potentially payouts are usually higher for crops grown on summerfallow rather than on stubble. The difference varies from area to area in the Province, with coverages on fallow about 5 to 50 percent above those on stubble. Premium costs per dollar coverage are also higher on stubble.

1. Do you generally purchase all-risk crop insurance? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 5 below.

2. Have any of the crops you grow been covered by a high-risk subsidy?

   ________ YES

   ________ NO

   ________ NOT SURE

3. Did these programs (crop insurance or the high risk premium subsidy) affect the way you managed your farm, or the crops you grew during the 1980's? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 5 below.

4. If "YES", in what ways did these programs affect your farming activities during the 1980's? PLEASE CHECK. (Ignore changes to your total land base through the purchase, sale and/or rental of land).

	INCREASE	NO CHANGE	DECREASE
Cultivated acreage	______	______	______
Summerfallow acreage	______	______	______
Forage acreage	______	______	______
Inputs (e.g. fertilizer, spray) per acre	______	______	______
Tillage operations	______	______	______
Livestock production	______	______	______

5. In general, do you believe the response of farmers to the All-Risk Crop Insurance Program has affected the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ____

____

Part VI. Crown Land Sales

Provincially owned land has been (and is being) sold to farmers for agricultural purposes. In recent years, most of these land sales have taken place in the Special Areas (East-Central Alberta) and the Improvement Districts (Peace River and Northeast) in response to a demand for land by farmers wishing to expand production, by community groups wishing to expand into a a certain area, and by newcomers wishing to try farming for the first time. The land is typically sold at its current market value. During the 1980's, Crown Land sales usually amounted to about 150,000 acres per year.

1. Have you purchased Crown Land in the last 10 years from the Alberta government? PLEASE CHECK ONE.

   _________ YES

   _________ NO

   If "NO", please go directly to 5 below.

2. How would you classify **this land** for agricultural production? PLEASE CHECK ONE.

	Good	Fair	Poor
Crop Production	_________	_________	_________
Livestock Production	_________	_________	_________

3. What did you use **this land** for in 1989? PLEASE INDICATE THE NUMBER OF ACRES FOR EACH LAND USE.

_________	Cereals/oilseeds	_________	Summerfallow
_________	Forages	_________	Improved pasture
_________	Other crops	_________	Unimproved land

4. Has there been any change to the quality (i.e., extent of erosion, salinity or organic matter) of the land you purchased from the Crown? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

   Please Explain: ____

   ____

   ____

5. In general, do you think that the quality (i.e. extent of erosion, salinity, or organic matter) of Crown lands sold to farmers in your area has changed relative to nearby privately-owned lands since being used for agricultural purposes? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

   Please Explain: ____

   ____

Part VII. Water Management Programs

A number of programs are presently operated by the Alberta government to facilitate water management in Central and Northern Alberta. These can involve a local government, a drainage authority, or a number of farmers. In the past, programs emphasized expanding the agricultural land base through improved drainage. More recently, multiple-use projects (i.e. agriculture, recreation, wildlife, flood control) have become increasingly popular. The Alberta government typically pays from 75 to 100 percent of the capital cost of off-farm improvements.

1. Have you ever participated in any of these water management projects? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 5 below.

2. If "YES", what was the name or type of program in which you participated?

   Name/type: ________________________________

3. What effect has your participation in this program had on each of the following? PLEASE CHECK.

	INCREASE	NO CHANGE	DECREASE
Area in annual crops	_____	_____	_____
Area in hay/forage crops	_____	_____	_____
Livestock water supplies	_____	_____	_____
Domestic water supplies	_____	_____	_____
Crop yields	_____	_____	_____
Crop damage from waterfowl	_____	_____	_____
Efficiency of field operations	_____	_____	_____
Other (specify: ______________________)	_____	_____	_____

4. Have you had any erosion problems because of this program? PLEASE CHECK ONE OR MORE.

	MORE	NO CHANGE	LESS
Water erosion	_______	_______	_______
Wind erosion	_______	_______	_______

   Please explain: ________________________________

5. In general, do you believe the response of farmers to these kinds of water management projects have affected the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ________________________________

____

____

Part VIII. Special Canadian Grains Program

The Special Canadian Grains Program was introduced in 1986 as a temporary measure to help farmers cope with low grain prices. The initial program was allotted 1 billion dollars Canada-wide with Alberta farmers receiving 261.8 million dollars. The program was repeated in 1987 with a Canada-wide allotment of 1.1 billion dollars, of which Alberta farmers received 300.6 million dollars. Special crops as well as cereals and oilseeds were covered in the second program. In 1987, one third of summerfallow acreage also qualified for benefits. Acreage sown to commercial hay, silage, or green feed did not qualify for payments in either year.

1. Did you receive a payment under the Special Canadian Grains Program in either year? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 5 below.

2. If so, did you expect a payment in the following year? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 5 below.

3. If you were expecting the program to continue, did this cause you to alter any of your decisions in managing your land? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 5 below.

4. How were your plans affected by your expectation of a benefit under this program? PLEASE CHECK. (Ignore changes to your total land base through the purchase, sale and/or rental of land).

	INCREASE	NO CHANGE	DECREASE
Cultivated acreage	____	____	____
Summerfallow acreage	____	____	____
Forage acreage	____	____	____
Inputs (e.g. fertilizer, spray) per acre	____	____	____
Tillage operations	____	____	____
Livestock production	____	____	____

5. In general, do you believe the response of farmers to the Special Canadian Grains Program has affected the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ____

____

____

Part IX. 1988 Crop Drought Program

Following the drought in 1988, the federal and provincial governments cooperated to provide assistance to compensate farmers for low yields. This program was intended to supplement income which farmers had already received from crop insurance benefits and from their actual harvested crop. Instead of using yields for a specific farm, average yields were determined by township for each crop using available crop insurance data. Since sufficient data did not exist for some crops, farmers were not compensated for losses suffered for marketed hay and commercial forage seed production. Using 1988 prices for the crops covered, farmers received payments equivalent to about 7.75% of the normal yields in their area in addition to any crop insurance payments. Alberta farmers received about 63.6 million dollars from the program.

1. Did you receive benefits for losses sustained during the 1988 drought under this program? (Note: This does not refer to benefits you may have received for crop insurance). PLEASE CHECK ONE.

   _________ YES

   _________ NO

   If "NO", please go directly to 5 below.

2. Do you expect a similar program to provide assistance if another drought were to occur? PLEASE CHECK ONE.

   _________ YES

   _________ NO

   If "NO", please go directly to 5 below.

3. Did your expectation of such a payment affected your farm management decisions in any way? PLEASE CHECK ONE.

   _________ YES

   _________ NO

   If "NO", please go directly to 5 below.

4. How were your plans for 1989 or 1990 affected by the prospect of payments under a **drought program?** PLEASE CHECK. (Ignore changes to your total land base through the purchase, sale and/or rental of land).

	INCREASE	NO CHANGE	DECREASE
Cultivated acreage	_____	_____	_____
Summerfallow acreage	_____	_____	_____
Forage acreage	_____	_____	_____
Inputs (e.g. fertilizer, spray) per acre	_____	_____	_____
Tillage operations	_____	_____	_____
Livestock production	_____	_____	_____

5. In general, do you believe the response of farmers to the 1988 Crop Drought Program has affected the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ____

____

Part X. Municipal Farm Land Assessment Procedures

Effective in 1985, certain changes were made to the assessment procedure on which farm property taxes are based. First, farm dwellings and the surrounding buildings are now a separate assessment unit compared to the land being farmed. Second, farm land in Alberta is being gradually re-assessed on the basis of productive value from an agricultural standpoint. Productive value is based on soil quality, location, typical farming practices in that region, current use of land, and similar factors. Undeveloped land is assessed at a lower rate depending on its suitability for grazing or other purposes. Assessments are generally based on the normal best use of the land for agricultural purposes.

1. Does or will the assessment of farm land by a productivity standard affect your land management decisions? PLEASE CHECK ONE.

   ________ YES

   ________ NO

   If "NO", please go directly to 4 below.

2. Did you clear, break or drain any land because of land tax regulations?

   ________ YES

   ________ NO

   If "YES", how many acres of each?

   Clear ____________ acres

   Break ____________ acres

   Drain ____________ acres

3. How were your plans affected or how will they be affected when **the above tax assessment procedure** based on potential agricultural productivity on your total land base is employed? PLEASE CHECK. (Ignore changes to your total land base through the purchase, sale and/or rental of land).

	INCREASE	NO CHANGE	DECREASE
Cultivated acreage	____	____	____
Summerfallow acreage	____	____	____
Forage acreage	____	____	____
Inputs (e.g. fertilizer, spray) per acre	____	____	____
Tillage operations	____	____	____
Livestock production	____	____	____

4. In general, do you believe the response of farmers to land tax assessment has affected or will affect the quality (i.e. extent of erosion, salinity, or organic matter) of agricultural land in your area? PLEASE CIRCLE ONE.

Strong Negative Effects			No Effects			Strong Positive Effects
-3	-2	-1	0	+1	+2	+3

Please Explain: ____

____

____

SECTION III

GENERAL INFORMATION ABOUT YOUR FARM

Please tell us something about your own farm operation.

1. What was the total area of your farm on July 1st, 1989?

   Owned area ________________ acres
   Rented area ________________ acres
   TOTAL AREA ________________ acres

2. How did you use this land in 1989?

   Cereals/oilseeds ________________ acres
   Hay/Improved pasture ________________ acres
   Other crops ________________ acres
   Summerfallow ________________ acres
   Unimproved pasture ________________ acres
   Other ________________ acres
   TOTAL AREA ________________ acres

3. Which one of the following best describes your farm? PLEASE CHECK ONE.

   ________ Grain/oilseed farm
   ________ Beef/dairy farm
   ________ Hog/poultry farm
   ________ Speciality crop farm
   ________ Mixed farm (livestock + crops)
   ________ Other (please specify) ________________________________

4. What was the total cash value of agricultural products sold from your farm in the 1989 calendar year? PLEASE CHECK ONE.

   ________ Under $10,000
   ________ $10,000 - $24,999
   ________ $25,000 - $44,999
   ________ $50,000 - $99,999
   ________ $100,000 - $249,999
   ________ Over $250,000

5. What operational changes have you made on your farm during the last decade (the 1980's)?

A. Changes in cultivated acreage: PLEASE INDICATE.

Brush/clearing	________	acres
Drainage	________	acres
Breaking of native pasture	________	acres
Re-seeding to pasture or forage	________	acres

B. Changes in land use on cultivated land: PLEASE CHECK.

	INCREASE	NO CHANGE	DECREASE
Summerfallow	____	____	____
Cereals/oilseeds	____	____	____
Hay/Improved pasture	____	____	____

C. Change in how you manage your crop residue (straw, etc.). PLEASE CHECK.

	INCREASE	NO CHANGE	DECREASE
Burn	____	____	____
Leave on/in field	____	____	____
Remove (sale or other use)	____	____	____

D. Changes in type of summerfallow: PLEASE CHECK.

	INCREASE	NO CHANGE	DECREASE
Conventional summerfallow	____	____	____
Minimum tillage summerfallow	____	____	____
Zero-tillage (chemical) summerfallow	____	____	____

E. Changes in input use **per cropped acre:** PLEASE CHECK.

	INCREASE	NO CHANGE	DECREASE
Fertilizer use	____	____	____
Pesticide (incl. herbicide) use	____	____	____
Fuel use	____	____	____
Irrigation	____	____	____

F. Changes in pre-seeding tillage operations: PLEASE CHECK.

	INCREASE	NO CHANGE	DECREASE
Number of operations (fall & spring)	____	____	____
Number of operations burying residues	____	____	____

G. Please check your typical crop rotation.

	1970's	1980's
Wheat-fallow	____	____
Wheat-wheat-fallow	____	____
Wheat-other cereal/oilseed-fallow	____	____
Wheat-other cereal/oilseed-other cereal/oilseed-fallow	____	____
Other (please specify):		
________________________	____	____
________________________	____	____

H. Changes in typical frequency of summerfallow. PLEASE CHECK.

	1970's	1980's
Every other year	____	____
Every 3rd year	____	____
Every 4th year	____	____
Less than once every 4th year	____	____
No summerfallow	____	____

I. Changes in livestock operations: PLEASE CHECK.

	MORE	NO CHANGE	LESS
Beef/dairy number	____	____	____
Poultry/hog number	____	____	____
Other ____________	____	____	____

6. If grain-livestock prices went up by 10 percent (and costs remained the same) or if production costs went down by 20 percent (and product prices remained the same), what major changes, if any, would you make to your farming operation? PLEASE EXPLAIN.

____

____

____

7. Other comments:

____

____

____

8. If you would like to receive a brief summary of survey responses, we would be happy to send that to you. If so, please provide a mailing address below:

____

____

THANK YOU FOR YOUR COOPERATION.

Return to: Rural Economy, University of Alberta, Edmonton, Alberta T6G 9Z9

APPENDIX D - USE OF THE NON-PARAMETRIC CHI-SQUARE TEST TO ASSESS STATISTICAL SIGNIFICANCE OF STUDY RESULTS

Parametric statistics are those which make an assumption about the parameters or type of the underlying frequency distribution. Most of the statistics in the study are non-parametric statistics. A farmer is asked to choose a response from one of several mutually exclusive groups of responses and the data presented are frequency distributions of the responses. There is no measurement between the intervals of the responses. A frequency distribution would simply be a graphing of the number of responses or percentage of responses for each response group. Since these types of discrete distributions cannot be analyzed in the same way as parametric statistics (for which intervals between the responses can be measured and assumptions can be drawn about the distribution), they are grouped as non-parametric statistics with a separate set of procedures for drawing inferences about how well they estimate the true responses for the total population. The chi-square test is a basic procedure for testing the confidence of non-parametric statistics.

In this case, for instance, assume we wish to determine whether the farmer responses indicate that the WGTA has a significant effect on soil quality. (These responses to question II.I.3.a are summarized in Table D.1). When asked whether the WGTA had affected the quality of agricultural land in their area, 573 responded that it had no effect, while 163 felt it had a negative effect, and 85 saw it having a positive effect. These are our observed values forming a sample of 821 responses (the remainder made no response to this question). To apply the chi-square test we first must make some assumption about the responses, determine the distribution of responses that would accord with our hypothesis, and test whether the actual responses are significantly different from the expected responses using our assumption.

If the responses had been equally divided among the three possibilities then no conclusions could have been drawn about the effects of the WGTA. This becomes our first null hypothesis. The expected distribution under this assumption is (821/3) or 273.7 responses per category (since the expected number of responses does not need to be an integer value). The χ^2statistic is then defined as:

$$\chi^2 = \frac{(273.7-163)^2}{273.7} + \frac{(573-273.7)^2}{273.7} + \frac{(273.7-85)^2}{273.7}$$

or $\chi^2 = 502.5$.

This chi-square distribution has two degrees of freedom. What this means is that since the total sample size has been chosen (821), once the frequencies have been chosen for two of the response groups, this will also determine the frequency of responses for the third group, i.e. there are two unknowns in this distribution. With two degrees of freedom a $\chi^2$of 10.6 is significant at the .005 level of confidence. Since our chi-square is greater than the test value of 10.6, we can reject the null hypothesis and will be wrong less (and probably much less) than 5 times out of 1,000. Since the null hypothesis was that no conclusions could be drawn, we decided that some conclusions can be drawn about the effects of the WGTA on soil quality from this survey.

Applying this very general test permits reaching the same conclusion for all of the programs. This means that our actual observations of the survey responses are significantly different from a random sample if each response has an equal likelihood of being made.

Chi-Square Test of Program Effects

Table D.1 gives a count of farmer responses as to whether each program included in the survey is perceived to have a negative, neutral, or positive effect on soil quality in their area. For non-parametric data such as obtained in this survey sample a chi-square test can be applied to determine the significance of survey results. Table D.2 shows the results of these tests as applied to the data of Table D.1.

By the chi-square test, survey responses are significant enough to draw some conclusions about the effect of the program on soil quality. In each case the majority of responses are that the program had a neutral effect on soil quality. To the degree of confidence of the sample size, the proportion of farmers indicating a specific program had no effect on soil quality should approximate this same proportion for all farmers.

Table D.1

Comparison of Farmers' Responses as to Whether Respective Programs Have a Negative, Neutral or Positive Effect on Soil Quality

		Number of Responses			
		Negative Effect	Neutral	Positive Effect	Total
(1)	WGTA	163	573	85	821
(2)	WGSA	90	644	108	842
(3)	CWB Quota	135	599	118	852
(4)	Farm Fuel Rebates	126	577	141	844
(5)	Crop Insurance	192	520	116	828
(6)	Crown Land Sales	114	559	55	728
(7)	Water Management Programs	73	417	261	751
(8)	SCGP	87	604	124	815
(9)	Crop Drought Program	55	651	90	796
(10)	Farm Land Assessment	124	614	68	806

Source: Questionnaire returns.

Table D.2

Results of the Chi-Square Test for Determining Whether Specific Programs Have an Effect on Soil Quality[a]

(a) Do the responses permit drawing a significant conclusion about the effect of the program on soil quality?

(b) Is the net effect of the program negative or positive?

		(a) Some conclusions?		(b) Net positive or negative?	
		χ^2	Result	χ^2	Result
(1)	WGTA	502.2	yes	24.5	negative
(2)	WGSA	706.1	yes	1.6	neutral
(3)	CWB Quota Policy	524.6	yes	1.1	neutral
(4)	Fuel Rebates	466.5	yes	.8	neutral
(5)	Crop Insurance	334.1	yes	18.8	negative
(6)	Crown Land Sales	625.6	yes	20.6	negative
(7)	Water Management	237.1	yes	105.8	positive
(8)	SCGP	612.3	yes	6.5	neutral
(9)	Crop Drought	843.2	yes	8.4	positive
(10)	Land Assessment	671.5	yes	16.3	negative
Degrees of Freedom		2		1	
χ^2 test value (99.5% confidence)		> 10.6		> 7.88	

[a] These were applied to the data of Table D.1.

Ignoring the responses indicating 'no effects', a test was also made on the net negative or positive effects of each program. By this procedure four programs: the WGSA, CWB quota policy, farm fuel rebates, and the SCGP appear to be neutral. The number of negative and positive responses do not differ by a large enough amount to discount the possibility that the program was perceived to have no net effect on soil quality.

Four programs are indicated to have a net negative effect on soil quality: the WGTA, crop insurance, crown land sales, and farm land assessment. Two programs, water management and the crop drought program have a net positive effect by this procedure. Water management has the largest chi-square value confirming its positive effect. The crop drought program, however, barely qualifies by this criterion with a chi-square value not very different from that of the Special Canadian Grains Program.

The test results indicate that for each of the programs, responses are adequate to draw conclusions about the perceived effect of the program on soil quality. Clearly the majority of responses in each case indicated that the program was perceived to be having a neutral effect. Testing the neutral response against a combination of the positive and negative responses indicates that, in each case, there is a significant chance that the program was seen to have a neutral effect on soil quality. However, this is least true for water management programs and crop insurance. Water management programs had the greatest chance of being seen to have some type of effect (negative or positive) on land management practices leading to a change in soil quality.

When the neutral effect responses are ignored (as in Table D.2), a test can be made on whether the net effects of the program are significantly negative or positive. As indicated above, this procedure suggests four programs: the WGSA, CWB quota policy, farm fuel rebates, and the SCGP are perceived to be neutral. Four programs are indicated as having a negative effect on soil quality: the WGTA, crop insurance, crown land sales, and farm land assessment. Two programs, water management and the crop drought program, are seen to have a positive effect by this procedure, with the crop drought program on the margin between positive and neutral.

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APPENDIX E - ADDITIONAL SOURCES OF SOIL DEGRADATION

Salinity

"Soil salinization is caused by transport of salt in soil solutions, followed by evaporation and precipitation in or on the soil. The balance of water movement between the soil and shallow groundwater can be altered by cultivation and be removal of perennial native vegetation, which is capable of greater transpiration than many agricultural crops so that the situation is worse under summerfallow, when no crop is grown. The net result is downslope migration of percolation water over slowly permeable till or bedrock, with enrichment in salt content from inherent subsoil salinity.

"Salinity in irrigated areas commonly occurs when water tables are raised in the vicinity of canals because of leakage, or as a result of seepage and excessive water application. As irrigation water raises water table levels or moves through the subsoil, it brings dissolved salts nearer the surface. When this water evaporates, the salt content of the remaining soil water increases until crop damage results and salt-tolerant weeds invade the area." (Coote et al. 1981, 46)

The result of high levels of salinity is to reduce germination and growth of most crops. While the tolerance of crops to salinity varies widely, even among varieties of a particular crop, the highest levels of tolerance to salinity are typically found in forages, with lower levels of tolerance in cereals and oilseeds. Vegetables appear to be among the most sensitive crops to salinity. (Coote et al. 1981, 46)

Dryland salinity appears to be increasing, but evidence appears fragmentary. (PFRA 1982, 27;Coote et al. 1981, 48) One calculation, while it appears highly suspect, suggests that salinity is responsible for perhaps three-quarters of the costs of soil degradation in the Prairie region. (PFRA 1982, 29, 107) Others (Anderson and Knapik 1984, 30, 55) suggest the costs of soil salinity are small in relation to the costs of erosion, but that they are significant nevertheless. The incidence of dryland salinity appears closely associated with cultural practices, in particular the use of summerfallow. (Coote et al. 1981, 48) Control measures include continuous cropping with salt-tolerant crops such as barley, seeding to forage crops if salinity is not sever, draining depressional areas where runoff collects, and subsurface drainage to remove water and lower the water table. Subsurface drainage is an relatively expensive remedy, however.

Salinity on irrigated lands appears associated largely with seepage from poorly constructed irrigation canals. Coote et al. quote one estimate that about 15 percent of irrigated land in Alberta may be so affected. However, current and recent activity in re-locating and lining canals should be alleviating that source of salinity. While wind can also be a mechanism for movement of salts, it does not appear this is or has been a serious issue, except perhaps in area-specific situations, such as locations downwind of an alkali lakebed.

From a conservation practices perspective, the main issue in salinization appears to be the practice of summerfallow. The degree to which summerfallow-induced salinization represents a growing problem appears difficult to estimate, but the consequences of reducing summerfallow in terms of soil erosion (wind or water) can be estimated, and the remedy for such salinization may be reduction of fallow.

Acidification

The major areas in Alberta in which acidification is a potential concern are in the central and northern regions of the Province, the Gray, Black and Solonetzic soils of these regions. While the soils have typically developed based on calcareous materials, leaching of the upper horizons may deplete them of calcium, and lead to pH values below 6.5, which are considered to present limitations for agriculture in these regions. (Coote et al. 1981, 59)

Soils which have become low in pH thus become susceptible to increases in acidity from ammonium fertilizers and from atmospheric/industrial sources. The use of fertilizers has increased, but atmospheric acidity in Alberta is generally low. (Coote et al. 1981, 59) Some atmospheric acidity appears to occur in localized conditions downwind of gas processing plants, but there are also cases (Gray Luvisolic soils deficient in sulfur) in which atmospheric sulfur transport is beneficial. (Coote et al. 1981, 59)

The practice of deep plowing has been used to increase the calcium content of upper layers of solonetzic soils, but may not be suitable for all areas. Liming appears to remedy problems due to acidification, but large applications may be needed in the vicinity of significant point sources of acidification (such as gas plants, sulfur stockpiles). Most of the perceived need for liming to maintain pH levels appears to be in the Peace River region of the province. (Coote et al. 1981, 59)

Compaction

Soil compaction or structure deterioration can cause conditions such that moisture infiltration or plant root extension is limited by high soil density. Compaction can be the result of mechanical disturbance by tillage, some by reduced organic matter as a result of tillage, or through excessive weight or speed of farm machinery. Soil compaction can also occur naturally in the absence of any of the above. (Coote et al. 1981, 35)

Measurement of the impact of compaction is probably difficult to separate from the overall effects of soil degradation due to wind and water, since it appears closely related to the number and type of tillage practices. However, soil compaction does not appear to be a major problem in Alberta, in view of the relatively low rainfall amounts experienced, the freeze-thaw conditions during winter, and the relatively high organic matter content of the soils. (Coote et al. 1981, 41)

Measurement Issues

The Erosion-Productivity Impact Calculator (EPIC) is unable to measure effects on output of salinity changes. The extent to which this may influence the study is unknown. However, a major source of salinization is associated with irrigation systems, particularly with leakage from such systems. The major dryland contributor to salinization appears to be the practice of summerfallow, the effects of which may partly be captured by the measurement of productivity effects of alternative rotations and practices through EPIC or related approaches. Acidification, at least to the degree that it is a reflection of fertilization strategy, may also be reflected in part through modelling activities. Soil compaction, to the apparently limited degree that it may be a significant issue in Alberta, appears largely related to management practices, and is also therefore somewhat intertwined with the measurement of erosion effects of selected farm practices.

APPENDIX F - SENSITIVITY OF EPIC MODEL EROSION ESTIMATES

The results of the analyses with the EPIC model in each region are based on soil topographic characteristics as follows:

Channel

length	100 metres	Field length	1 km
slope	5 percent	Field width	0.5 km
		Field angle	north-south

Land slope

length	85 metres
steepness	6 percent

The estimates of rates of erosion therefore strictly apply only to the soil characteristics indicated and the soil types used. For this reason, the following comments are directed toward the sensitivity of erosion loss estimates to alternative assumptions concerning topography and soils.

During the course of the analysis, some trends became apparent. In addition, several EPIC simulations were carried out with the purpose of testing the impact of alternative assumptions. In the Southern Alberta soil type, channel length and slope did not appear to markedly influence erosion estimates. Varying channel length between 100 and 150 metres, and slope between 5 and 7 percent, produced insignificant changes in erosion over a period of 50 years.

Other factors did influence erosion levels, however. Land steepness, in particular, appears to have a major impact. Results from use of the southern Alberta profile (Warner) are illustrative:

50 YEAR EROSION RATES,
WWF ROTATION, SOUTH ALBERTA
ALTERNATIVE SLOPE STEEPNESS

Steepness of Slope (%)	Length of Slope (m)	50 Year Erosion (mm)
2%	85	13.4
4%	85	22.0
6%	85	35.3
8%	85	52.1
10%	85	72.5

Source: EPIC Simulations. WWF indicates wheat, wheat, fallow rotation.

None of the rates of erosion shown led to a negative yield trend over the simulated 50 year period. Further, evidence indicates that the relationships between steepness of slope and erosion are characteristic of other regions as well, including gray soils. For example, the simulated 50 year erosion of a gray soil with weather conditions typical of the Peace River region indicates the following:

Canola-Barley-Barley-Fallow Rotation

Erosion (50 year) with 1 percent slope 4.7 mm.

Erosion (50 year) with 6 percent slope 32.4 mm.

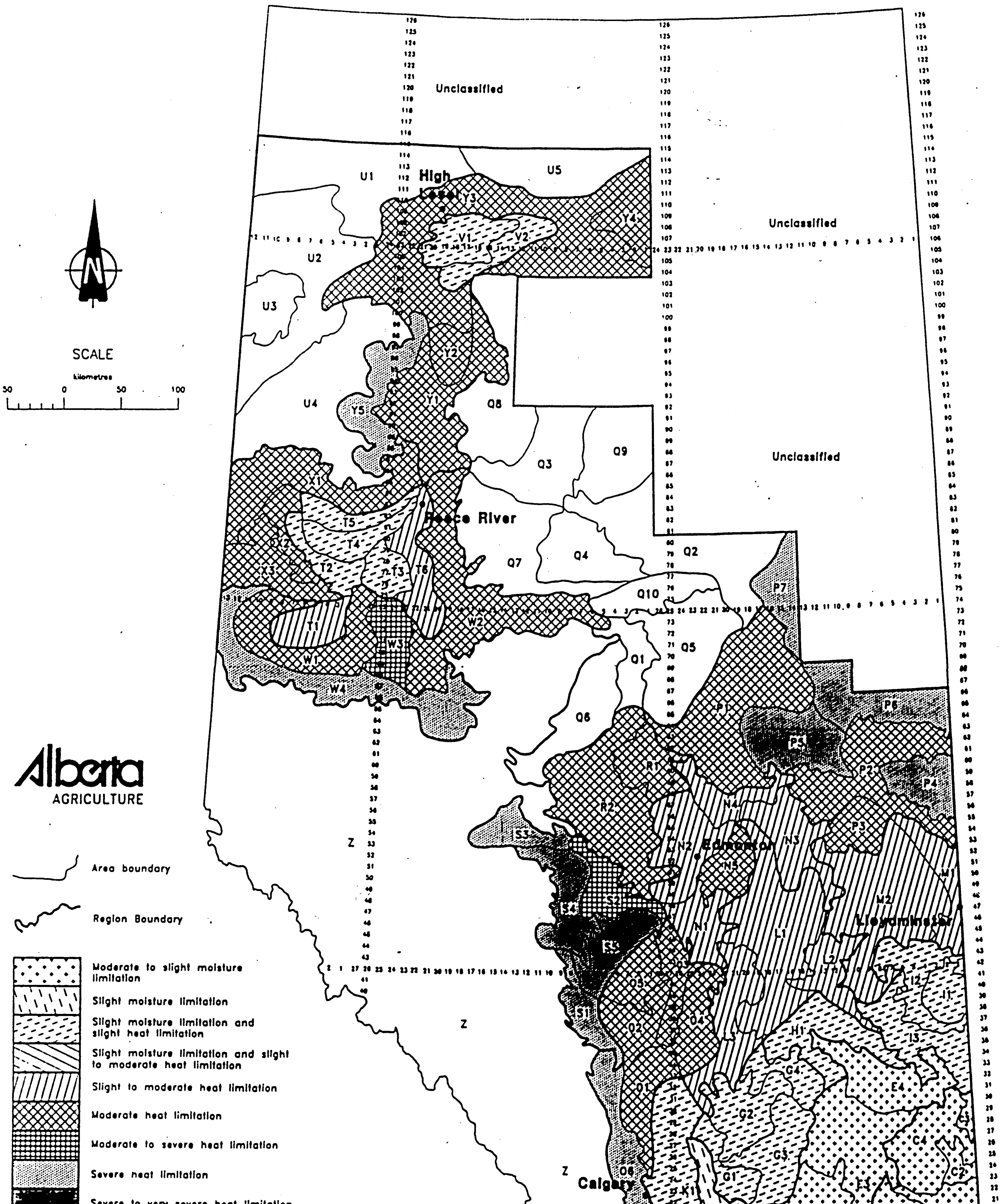
Professional opinion appears to indicate 1-2 percent is more appropriate for major soils of the Peace River region than is the higher number (Coen and Tajek, Personal communication, October 1990).

APPENDIX G - AGROECOLOGICAL REGIONS MAP

Reduced cultivation further reduces the erosion estimate, but only slightly, from 4.7 mm. with a one percent slope (from the preceding example) to 3.9 mm. In this soil profile, increasing the channel length did increase the erosion loss estimate, however. A wheat-barley-fallow rotation (Peace River area), 6 percent slope, with a 200 metre channel length, simulated a soil loss of 45.9 mm. in 50 years, while a similar rotation on a field with an 100 metre channel length estimated an equivalent erosion loss of 35.2 mm.

In general, erosion loss estimates appear sensitive to changes in fallow practice. For example, a wheat-barley-fallow rotation (Central Black soil, 6 percent slope) simulates a 50 year loss of 32.8 mm. of soil. Changing to continuous cropping (WCBB) reduces the 50 year loss to 11.1 mm. Continuous cropping with forages leads to no additional reduction in soil loss.

APPENDIX G - AGROECOLOGICAL REGIONS MAP



Alberta
AGRICULTURE

Area boundary

Region Boundary

Moderate to slight moisture limitation

Slight moisture limitation

Slight moisture limitation and slight heat limitation

Slight moisture limitation and slight to moderate heat limitation

Slight to moderate heat limitation

Moderate heat limitation

Moderate to severe heat limitation

Severe heat limitation

Severe to very severe heat limitation

Agro-climate estimated (mainly severe to very severe heat limitation)

Source Modified From: Agroecological Resource Areas of Alberta Map by W. W. Pettapiece, 1989
Compiled by Conservation and Development Branch, Alberta Agriculture

AGRO-CLIMATIC CLASSIFICATION OF AGROECOLOGICAL RESOURCE AREAS OF ALBERTA