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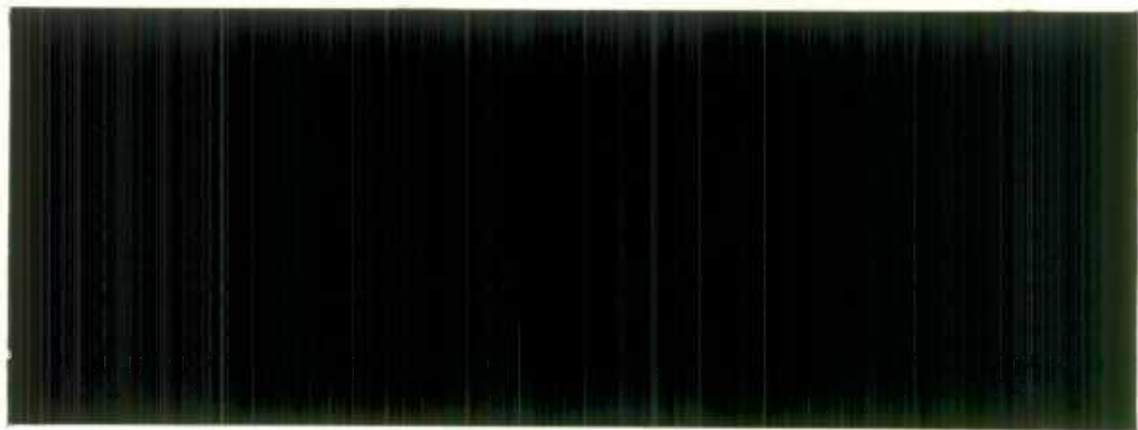
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PRAIRIE SUMMERFALLOW INTENSITY: AN ANALYSIS  
OF 1981 CENSUS DATA

WORKING PAPER NO. 8

Les Macartney

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Preface

Summerfallow is a common farm practice on the prairies. It has become a high-profile topic in recent years due to the general recognition that summerfallow is a major source of soil degradation. The purpose of this paper is to define the summerfallow phenomenon in general terms and to provide information useful in considering routes to be taken in assisting farmers to decrease the area in fallow.

The author expresses appreciation for the assistance of a number of colleagues in the Agriculture Statistics Division. Special thanks are due: Robert Plourde for suggesting a descriptive report on summerfallow; Brenda Clarke for reliable work in generating census tabulations; Brad Snider and Ray Bollman for helpful, constructive criticism.



Abstract

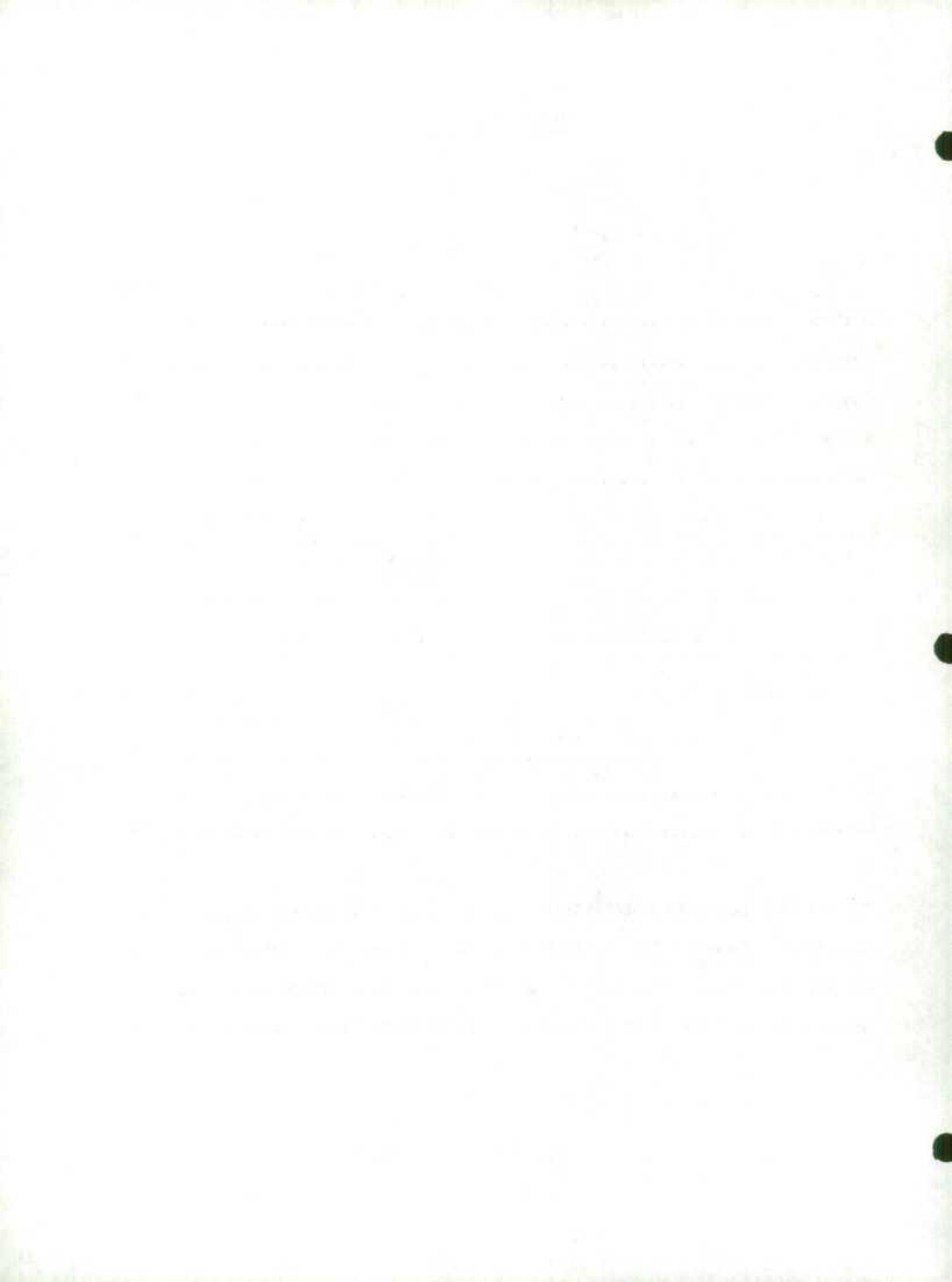
This descriptive study provides background information for the current debate on the benefits and costs of the summerfallow practice in the Prairies. The study focuses mainly on dryland grain farms with some land in fallow. The relation between the ratio of summerfallow to cultivated area (called summerfallow intensity) and the following nine variables is examined: farm cultivated area, farm organization, land tenure, age of operator, days of off-farm work, fertilizer and agriculture chemical expenses, machinery value and gross farm sales. Data are analyzed by soil zone, a proxy for soil moisture. Cross tabulation and correlation are the statistical tools used.

The findings document that summerfallow practice varies by soil zone and province. Saskatchewan farms are significantly more oriented toward the practice and have experienced the least reduction in area fallowed. Cross tabulations show that, in the Brown and Dark Brown zones, intensity is unrelated to changes in most of the nine variables. In the Black and Gray zones, general tendencies are detected which are frequently small in magnitude. Summerfallow intensity trends upward with increasing age, and consistently trends downward with increasing farm cultivated area, ag chemical expense per acre, machinery value per acre and gross sales. For fertilizer expense per acre in the Black zone, the intensity trend is not only consistent but is significant in magnitude.



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## Introduction

The practice of summerfallow, the idling of cultivated land for a growing season, is widespread in the Prairie Provinces. In 1983, 22 million acres were fallowed. Over the last several decades total summerfallow(SF) area has been almost as large as wheat area; in certain years greater. Although total SF area has been trending downward during the last decade, it presently occupies much more land than any crop except wheat. Summerfallow is currently at issue because of the desire to increase grain production and because summerfallow is a major source of soil degradation.

Many farmers derive advantage from summerfallow. A recent sample survey of Alberta farmers (Anderson, 1981, pp. 58-61) indicated that the main reasons for following SF management, in descending order, are:

- i) moisture conservation,
- ii) weed and pest control,
- iii) income stability,
- iv) acceleration of the breakdown of crop residues, and
- v) reduction of commercial fertilizer requirements.

These reasons are not mutually exclusive since moisture conservation, through decreasing dependence on precipitation during the growing season, is related to obtaining more consistent yields and more stable income. Also, the summer-fallow practice is known to promote nitrification in the soil, by contributing to the rapid breakdown of organic matter, and is therefore connected to savings in commercial fertilizer. It is, in any case, clear that tangible benefits accrue to farmers in spite of the opportunity cost associated with holding productive land in fallow and of the mechanical and/or chemical costs needed to keep the land free of vegetation during the growing season. Statistics Canada (STC) data show that, for wheat seeded on fallow and on stubble land, fallow yields may be significantly greater than stubble yields. Wheat yields from fallow land can be 35% greater than stubble yields (STC, 1984, p. 8), depending on native soil fertility and on varying input applications.

Contrasting with the immediate benefits of summerfallow, there is a consensus among soil scientists that summerfallow has adversely affected soil quality over the last several decades.

The excessive tillage associated with the practice of summerfallow has resulted in up to a 50 per cent decrease in soil organic matter, a serious wastage in soil nitrogen, deterioration in the surface soil tilth or structure, and a rather alarming increase in soil salinity. At the same time, it (summerfallow) has been a major cultural practice that has lowered the efficiency of crop use of available water (Rennie, 1978).

Rennie goes on to review the scientific literature which supports the above quotation. There seems little doubt there exists a situation where the short-term benefit of summerfallow outweighs the long-term costs of the practice in the mind of the producer. There are indications that many farmers are aware of the situation (Anderson, 1981, pp. 61-62) but are constrained by the physical environment and by market factors. There is no question that the native fertility of prairie soils could be replenished through growing more forage crops. Production of meat and livestock products would be increased. Yet concentrated grain production throughout many parts of the Prairies suggests that the returns to cattle production are relatively lower. Rather than expand cattle production, the next best alternative is to move toward more continuous cropping of grain. This can happen only with more effective use of precipitation and with market prices that cover additional input costs.

The interests of grain marketing organizations, notably the Canadian Wheat Board, appear to coincide with those of soil scientists concerning the need to decrease SF area. The Board sponsored a symposium in October 1980 at which it set grain export targets to 1990. These targets were based on realistic projections of increasing world demand (Jarvis, 1980). A number of agricultural scientists and economists provided objective assessments of various dimensions of the grain production system. Scenarios were developed which integrated the factors of production. It was determined that the export targets were realizable with manageable shifts in land use patterns, developments in genetic knowledge, and increases in fertilizer and agricultural chemical application. Significant reduction in SF area was a key component of each of the basic scenarios considered (Acton et al., 1980).

Much public interest has been generated by the clash of short and long run perspectives on the summerfallow phenomenon. The purpose of this paper is (a) to provide general information about the phenomenon, and (b) to assess the impact of selected variables on farmer orientation toward summerfallow. The latter part of the paper will focus mainly on dryland grain farms with some area in fallow and will be of particular interest to those concerned with exploring ways of encouraging a shift of land out of fallow into grain and forage crops.

### Data and Concepts

This section outlines the data source, the fundamental concepts and the variables considered in the analysis.

The 1981 Census of Agriculture database is employed. The census, conducted in June every five years, gathers data on areas assigned to fallow and seeded to crops, on land tenure, operator age, operating expenses and data on a wide range of other variables. The census is used by statisticians to maintain time series and to benchmark on-going sample surveys. From the standpoint of this study, the main advantage of census data is that detailed analysis is possible. With the application of computer technology, a multi-dimensional profile of a specific sub-population of farms may readily be compiled. For example, the researcher can center analysis on farms with some land in fallow, having no irrigation system and with a specific level of agricultural sales revenue.

Basic to this analysis are the concepts of Soil-Climatic Zone and Product Farm Type. The amount of land in fallow is thought to vary by soil-climatic zone and by the type of commodity produced.

Soil-Climatic Zone - There are basically four zones in the Prairie agricultural region: Brown, Dark Brown, Black and Gray. Each of the four zones is defined in terms of soil moisture and soil organic matter. Levels of precipitation increase as we move from the Brown to Dark Brown to Black and

Gray zones. As well, moisture efficiency generally increases with movement in this direction<sup>1</sup>. Evaporation, for example, is higher in the warmer Brown than in the cooler Black and Gray zones. Accompanying higher moisture levels are higher levels of soil organic matter as we move from Brown to Black and Gray zones (Rennie and Ellis, 1979, pp. 9, 14). The first three zones developed under a grassland ecosystem. Organic matter composition in the Gray zone is generally lower than in the Black zone because the soil developed under wooded conditions and did not benefit from a fibrous grass rooting system. The location and size of each of the four zones is illustrated in the outline map on page 5 of this paper.

Since zonal data were not gathered on the census questionnaire, census geographic units, called census consolidated subdivisions,<sup>2</sup> were coded to each of the four soil-climatic zones. Subdivision boundaries were superimposed on a soil map of the Prairies and, if 50% or more of the soil in a subdivision fell into one of the zones, the subdivision was classified to that zone. The number of subdivisions in Manitoba, Saskatchewan and Alberta are respectively: 115, 305 and 65. In most cases subdivisions were readily classified but in the northern agricultural areas it was a more difficult task due to intermingling of Black and Gray soils. Maps of census consolidated subdivisions are shown in the back of each of the provincial census publications listed in the census publications in the References.

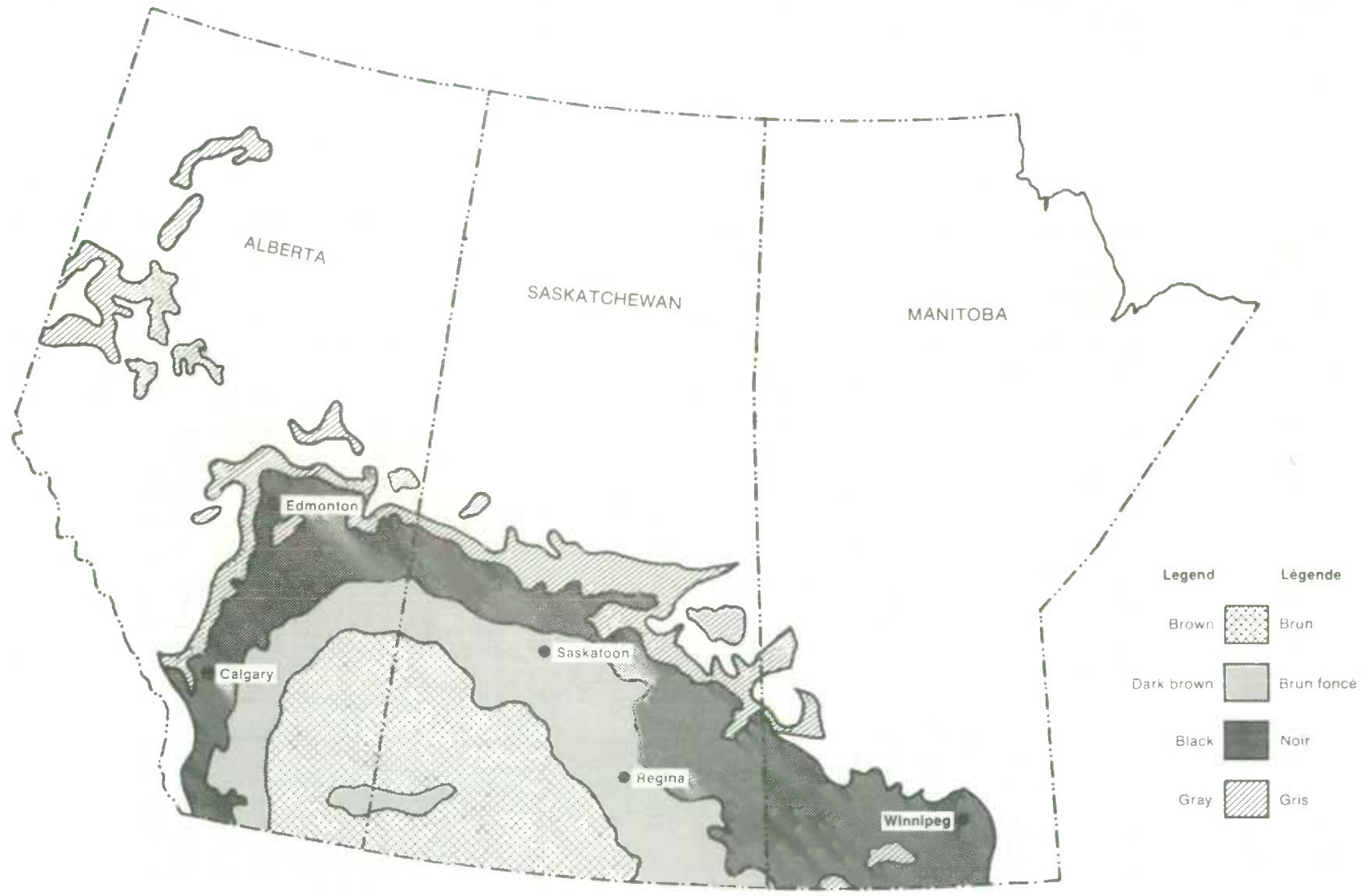
All prairie subdivisions having cropland area were classified to a soil-climatic zone. Manitoba subdivisions were coded either Black or Gray while Saskatchewan and Alberta subdivisions were classed either Brown, Dark Brown, Black or Gray. In 1981 there were 77.8 million acres (31.5 million hectares) of cultivated land in the Prairie Provinces. Total cultivated land is distri-

<sup>1</sup> Quantitative information about moisture efficiency is provided in Dumanski and Stewart (1983).

<sup>2</sup> The subdivisions are called rural municipalities in Manitoba and Saskatchewan, while in Alberta they are called counties, municipal or improvement districts.



Outline Map of the Prairie Provinces Showing Major Soil-Climatic Zones  
Carte des provinces des prairies indiquant les principales zones pédologiques



buted roughly as follows: Brown 20%, Dark Brown 25%, Black 40% and Gray 15%. A more detailed breakdown by zone and province is provided in Appendix A, Table A.5.

Farm Product Type - Each census farm, defined as having sales greater or equal to \$250, was assigned a major enterprise type according to the cropland and livestock reported on the census questionnaire. Potential sales revenue was estimated for each product or product group and the individual sales figures accumulated to determine the farm's dominant product type. The commodity or commodity-group which accounted for 51% or more of total potential sales was the product type assigned to the farm<sup>1</sup>. The farm product types include: wheat specialty, small grains excluding wheat specialty farms, field crops other than small grains, cattle, hogs, dairy, poultry, fruits and vegetables, miscellaneous specialty farms (greenhouses, nurseries, mushroom houses, apiaries, horses, etc) and mixed farms. There is SF area on all these farm types (Appendix A, Table A.4.) but more than four-fifths of the total SF area in the Prairie Provinces is on wheat and small grain farms. The analysis is therefore confined to these two farm types.

The farm definition is sharpened to include wheat and small grain farms:

- 1) with some SF area;
- 2) with gross agricultural sales of \$10,000 or more in 1980, and
- 3) without a formal irrigation system.

Irrigated farms are excluded as they follow different cropping practices than dryland farms and farms having less than \$10,000 ag sales may be considered non-economic. Prairie wheat and small grain farms satisfying these three criteria are subsequently referred to as Wheat Farms and Small Grain Farms and collectively the two farm types are referred to as Grain Farms.

<sup>1</sup> A detailed description of the method used in imputing farm type, based on census cropland areas and livestock inventories, can be found in Lennox, 1983.

This analysis encompasses 61,836 Grain Farms. In 1981, these farms represented 62% of all census prairie farms with some land in fallow and accounted for 77% of total prairie SF area. Of the 18.0 million acres (7.3 million hectares) of SF land in Grain Farms in 1981, 76% of this area is in Saskatchewan, 19% in Alberta and 5% in Manitoba (Table 1). Summerfallow area on Grain Farms is distributed among zones as follows: 29% Brown, 34% Dark Brown, 28% Black and 9% Gray. These percentages accurately reflect the relative importance of these provinces and zones with respect to total SF area in the Prairie Provinces.

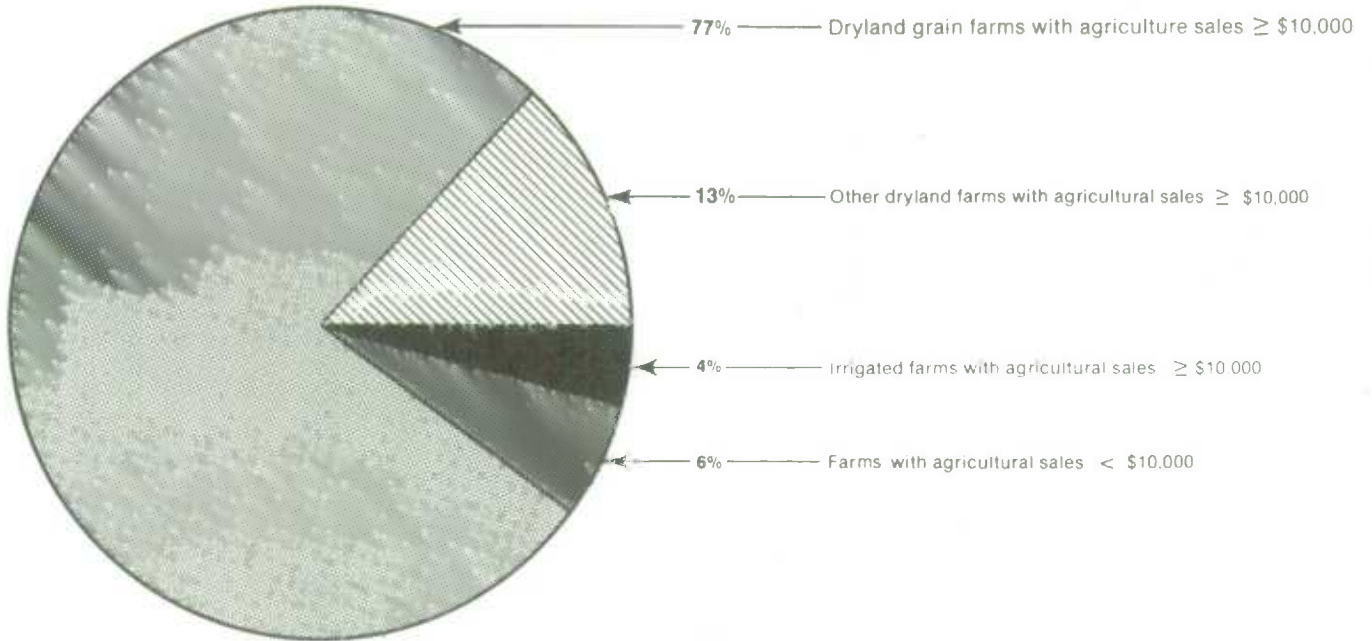
Variables - The central variable in this analysis is SF intensity. Intensity is defined as the ratio of summerfallow to cultivated area, where cultivated area is land seeded to annual field crops plus land assigned to fallow. Most field crops, such as cereal grains, oilseeds, potatoes, field peas and beans, are annually seeded. Tame hays, listed on the census questionnaire as field crops, are usually seeded no more frequently than once every sixth year and are excluded because land in alfalfa, alfalfa-brome grass mixture and other hays is usually kept in these crops rather than entering a regular crop rotation. Fruits and vegetables, other than potatoes, were also excluded from the cultivated-area denominator as the prairie area seeded to these crops is very small. Since SF intensity focuses only on annual crops that may enter a SF rotation, intensity indicates the length of crop rotation. Higher intensities suggest shorter rotations and lower intensities suggest longer rotations.

The following nine census variables are to be associated with SF intensity:

- cultivated area,
- farm organization,
- land tenure,
- age of farm operator,
- days of off-farm work by operator,
- fertilizer expense per unit of cropland,
- agricultural chemical expense per unit of cropland,
- value of farm machinery per unit of cultivated land, and
- gross farm sales.

Chart -- 1

**Distribution of Summerfallow Area on Census Farms, 1981**



Source: 1981 Census of Agriculture

Table 1. Percentage Distribution of SF Area on Grain Farms, by Province and Soil-Climatic Zone, 1981

	Brown	Dark Brown	Black	Gray	Total
Manitoba	-	-	4.1%	0.9%	5.0%
Saskatchewan	22.9%	29.1%	19.1%	4.7%	75.8%
Alberta	5.9%	4.8%	4.7%	3.8%	19.2%
Total Prairies	28.8%	33.9%	27.9%	9.4%	100.0%



Fertilizer and ag chemicals are taken per unit of cropland because grain farms apply fertilizer and most, but not all, ag chemicals on cropland. Machinery expense, on the other hand, is taken per unit of cultivated land as it is difficult to break equipment out on a cropland or summerfallow basis.

The census database is comprehensive but it inevitably does not fill all data needs. For the purpose of this study, it would have been helpful if a more detailed breakdown of fertilizer and of ag chemical expenses were available. Data for nitrogenous fertilizer expense and herbicide expense would be more specific as regards summerfallow. As a result, it was assumed that farmers' nitrogenous fertilizer expense is closely correlated with total fertilizer expense, and their herbicide expense is closely correlated with total ag chemical expense. Neither of these two assumptions would appear open to serious question. Another limitation is that the census, conducted in early June 1981, collected financial data for 1980 and data for most other variables for 1981. These drawbacks exist because the costs of carrying out back-to-back censuses to match financial data with other data is prohibitively high and the census questionnaire is designed to minimize farmers' response burden.

### Data Analysis and Findings

This section initially considers aggregate summerfallow and cultivated area on all census farms as background for the subsequent discussion. Then the emphasis shifts to SF intensity on Grain Farms. The extent of association between intensity and each of the other variables is examined via cross tabulation and correlation analysis.

All Census Farms - Census data on SF area in the prairie region extend back to 1921. SF area expanded rapidly in all three provinces between 1921, 1931 and 1941 and has been greater than twenty million acres (nine million hectares) in subsequent years (Appendix A, Table A.2). Comparison of data over the last few censuses is limited by the impact of the 1970 Lower Inventories for

Tomorrow program which resulted in a substantially increased SF area in 1970 and consequently a lower than normal level of summerfallow in 1971. From 1976 to 1981, however, there was an unequivocal reduction in SF area both in absolute terms and as a ratio of cropland area. Sample survey results corroborate the direction of this movement and point to a continued trend through to the latest growing season (1984).

Total SF area in the Prairie Provinces decreased by 3.1 million acres (1.2 million hectares) between 1976 and 1981 (Table 2). Fallow area has been falling at varying rates in different zones and provinces. Focusing on the Black and Gray zones, the cutback has been most pronounced in Manitoba and Alberta with Saskatchewan registering significantly less reduction. In the Manitoba Black and Gray zones, SF area dropped a substantial 38.6% and 23.7% respectively. Comparing the Dark Brown zones, the per cent reduction in Alberta is much greater than in Saskatchewan. Interestingly, SF area in the Brown zones of both Alberta and Saskatchewan ran counter to the trend and edged upward.

The persistence of summerfallow in the Brown zone appears largely due to semi-arid conditions. Soil moisture deficiency is a key factor limiting grain production in the Brown and, to a less extent, in the Dark Brown zone. Summerfallow serves to mitigate the moisture deficit even though summerfallow stores only 15-20% of precipitation during the months the land is lying fallow.

Under the conditions which prevail in southern Saskatchewan, the moisture stored in the 21 month summerfallow period is usually only 15 to 20 per cent of the precipitation received. During the summer the losses are largely due to evaporation and sometimes run-off. In winter the snow is held fairly well on stubble fields but frequently blows off bare summerfallow. Much of the accumulated snow may be lost as run-off if a rapid thaw occurs in the spring. The loss from evaporation is usually small in winter, although it may be appreciable when chinook winds occur. (Staple and Lehane, 1952).

Despite these limitations, summerfallow generally makes a significant contribution to soil moisture. More than thirty years ago Staple and Lehane reported a 10.2 cm moisture reserve on SF land and a 5.6 cm reserve on stubble

Table 2. Summerfallow Areas by Province and Soil-Climatic Zone, All Census Farms, 1976 and 1981

Province & Zone	Units	1976 000's	1981	% Change
<u>Manitoba</u>				
Black and Gray	ac	2,308.2	1,478.5	-35.9%
	ha	934.1	598.3	
<u>Saskatchewan</u>				
Brown	ac	4,909.3	4,931.6	+0.5%
	ha	1 986.7	1 995.7	
Dark Brown	ac	6,257.1	6,098.7	-2.5%
	ha	2 532.2	2 468.1	
Black and Gray	ac	6,592.2	5,536.8	-16.0%
	ha	2 667.8	2,240.7	
<u>Alberta</u>				
Brown	ac	1,646.9	1,692.3	+2.8%
	ha	666.5	684.9	
Dark Brown	ac	1,540.6	1,296.2	-15.9%
	ha	623.4	524.6	
Black and Gray	ac	3,307.0	2,461.3	-25.6%
	ha	1 338.3	996.0	
<u>Prairie Provinces</u>				
Brown	ac	6,556.2	6,623.9	+1.0%
	ha	2 653.2	2 680.6	
Dark Brown	ac	7,797.7	7,395.0	-5.2%
	ha	3 155.6	2 992.6	
Black and Gray	ac	12,207.4	9,476.6	-22.4%
	ha	4 940.2	3 835.0	
<u>Total Prairies</u>	ac	26,561.3	23,495.5	-11.5%
	ha	10 749.0	9 508.3	

Source: 1976 and 1981 Censuses of Agriculture

land, resulting in a SF gain of 4.6 cm. While subsequent research indicates that improved snow management can narrow the moisture differential (e.g. de Jong and Cameron 1980; Nicholaichuk, 1980), the small extra amount of moisture from summerfallow is more consistent from year to year than moisture from improved snow retention. In semi-arid areas, often prone to variable precipitation, summerfallow stabilizes yields and is a form of crop insurance.

Despite total SF area in the Brown zones of Saskatchewan and Alberta edging upward from 1976 and 1981, SF area expressed as a ratio of cultivated area decreased marginally (Table 3). This is due to cultivated area growing at a slightly higher rate than SF area in these zones. Since cultivated area increased in all provinces and zones between 1976 and 1981 and SF area decreased in the non-Brown zones, the ratios of fallow to cultivated area (SF ratios) generally decreased. It is noteworthy that a relatively modest decrease in the SF ratio occurred in the Saskatchewan Dark Brown zone which accounts for more SF area than any other provincial zone (Appendix A, Table A.5).

Hedlin (1980) has established objectives for the reduction of fallow land stated in terms of SF ratios. These objectives, based largely on moisture considerations, were set at .10 for the Black and Gray zones and .20 for the Dark Brown zone. The former goal appears realizable as it is agronomically feasible to decrease SF area in the Black and Gray zones to practically nil. In the Dark Brown zone, however, moisture conservation through improved snow management is needed to reach the .20 goal. No objective was set for the Brown zone. An informal survey of soil scientists indicates that some decrease in summerfallow may be expected in the Brown zone with more effective use of trash cover to retain snow in the field and with increased use of minimum tillage.

Projections to 1991 suggest that the .10 objective will almost be reached in the prairie-wide Black and Gray zone. Average annual rates of change in summerfallow and cultivated area between 1976 and 1981 were used to exponentially forecast SF ratios to 1991 for the prairie region. The

Table 3. Ratios of Summerfallow to Cultivated Area by Province and Soil-Climatic Zone, All Census Farms, 1976 and 1981

<u>Province &amp; Zone</u>	1976	1981	Change
<u>Manitoba</u>			
Black and Gray	0.222	0.133	-0.089
<u>Saskatchewan</u>			
Brown	0.468	0.456	-0.012
Dark Brown	0.438	0.413	-0.025
Black and Gray	0.387	0.303	-0.084
<u>Alberta</u>			
Brown	0.406	0.384	-0.022
Dark Brown	0.362	0.293	-0.069
Black and Gray	0.251	0.176	-0.075
<u>Prairie Provinces</u>			
Brown	0.451	0.435	-0.016
Dark Brown	0.420	0.385	-0.035
Black and Gray	0.301	0.219	-0.082
<u>Total Prairies</u>	0.361	0.302	-0.059

Background data are shown in Appendix A, Table A.5.

Source: 1981 Census of Agriculture



resulting ratios for the Brown, Dark Brown and Black and Gray zones are respectively .404, .324 and .115. It thus appears that the challenge during this decade will be to achieve the .20 objective in the Dark Brown zone.

In evaluating these extrapolated ratios, it is worth noting that producers' cultural practices are influenced by the economic environment. A considerable portion of the reduced SF area and increased cultivated area, occurring from 1976 and 1981 was attributable to a favourable international grain marketing situation that may not continue through the eighties. Commodity and farm input price movements subsequent to 1981 will affect the accuracy of the above forecasts. One thing is clear however: much of the shift out of fallow will occur in the Black and Gray zones. Of the projected 4.4 million acre (1.8 million hectares) reduction in prairie fallow area by 1991, 86% comes from Black and Gray soils<sup>1</sup>.

Grain Farms - The SF intensities on Grain Farms (dryland wheat and small grain farms with fallow land and ag sales greater or equal to \$10,000) retain the same ordinal pattern between provinces and soil-climatic zones as the SF ratios for all census farms (Table 4). Within given zones, intensities are the highest in Saskatchewan and are the lowest in Manitoba. The general level of intensities on Grain Farms is higher than the SF ratios of all census farms since the focus is now on dryland farms that are heavier users of summer-fallow. Comparing Grain Farm intensities (Table 4) with 1981 SF ratios (Table 3), the largest differences occur in the Black and Gray zones and the smallest differences are in the Brown and Dark Brown zones. The SF ratio and the Grain Farm intensity of the Alberta Brown zone differ somewhat. The latter difference is due in large part to extensive irrigation in southern Alberta. When the focus is just on Grain Farms (Table 4), there is little difference between the Alberta and Saskatchewan Brown zone intensities.

Grain Farms include Wheat Farms and Small Grain Farms. Wheat Farms have significantly higher SF intensities, implying shorter crop rotations, than Small Grain Farms (Table 4). Besides finding that crop rotations vary by farm

<sup>1</sup> Sample survey estimates indicate that SF area is decreasing at a more rapid rate but these estimates continue to indicate that much of the decrease is in the Black and Gray zones.

Table 4. Summerfallow Intensities of Grain Farms by Province and Soil-Climatic Zone, 1981

Province & Zone	Wheat Farms	Small Grain Farms	Grain Farms
<u>Manitoba</u>			
Black	0.241	0.171	0.196
Gray	0.261	0.230	0.244
<u>Saskatchewan</u>			
Brown	0.466	0.414	0.464
Dark Brown	0.431	0.354	0.425
Black	0.354	0.281	0.330
Gray	0.304	0.257	0.279
<u>Alberta</u>			
Brown	0.456	0.401	0.448
Dark Brown	0.393	0.299	0.349
Black	0.322	0.216	0.241
Gray	0.319	0.245	0.255
<u>Total Prairies</u>	0.406	0.254	0.359

Source: 1981 Census of Agriculture

Note: The intensities of Table 4 are calculated by dividing total SF area by total cultivated area for all farms in each table cell. Unless noted otherwise, the intensities referred to in this section are similarly obtained. There is little difference in magnitude between these intensities and those arrived at by first calculating the SF intensity of each farm and then calculating the average intensity. See Appendix A, Table A.8.

type, background research also reveals that, within the same zone, Wheat Farms are less diversified than Small Grain Farms in terms of the number of crops grown per farm. Although differences in intensity and diversification between the two farm types make for interesting description, these differences appear to be largely definitionally determined. Wheat Farms are defined to obtain 51% or more of gross ag sales from the marketing of wheat whereas Small Grain Farms are defined to cover any combination of the principal grain and oilseed crops, including wheat when it accounts for less than 51% of ag sales. Also, Small Grain Farms are more numerous in the Black and Gray zones where moisture does not limit the range of crops growable. Since it is true by definition that Small Grain Farms are more diversified and have longer rotations than Wheat Farms, any conclusions from contrasting these two farm types would be tautological. Consequently, the following discussion concerns Grain Farms.

Individual Farm Intensities - Examination of how individual farm (micro) intensities are distributed provides interesting insight into the summerfallow practice. The SF intensities provided in Table 4 are obtained by dividing total SF area by total cultivated area for each zone and therefore provide no information about how micro intensities are distributed within zones.

Frequency distributions of micro intensities for Saskatchewan Grain Farms in the Brown, Dark Brown and Black zones are illustrated in Chart 2 and similar distributions for Grain Farms in the Black zones of Manitoba, Saskatchewan and Alberta are displayed in Chart 3. Relative frequency of farms (i.e. the proportion of farms in each zone) is on the vertical axis while SF intensity is on the horizontal axis of each chart. The scales of both charts are the same to allow comparison.

Inspection of Charts 2 and 3 confirms that micro intensities are dispersed according to soil-climatic zone and province. The distributions become less peaked with lower aggregate intensities at the provincial and zonal levels. Referring to Chart 2, the values are obviously most frequent at the 0.50 level. Roughly 25% of Grain Farms in the Brown zone have a summerfallow intensity of 0.50, as do 15% of these farms in the Dark Brown zone and 5% of



Chart — 2  
**Frequency Distributions of Summerfallow Intensity on Saskatchewan Grain Farms in the Brown, Dark Brown and Black Zones, 1981**

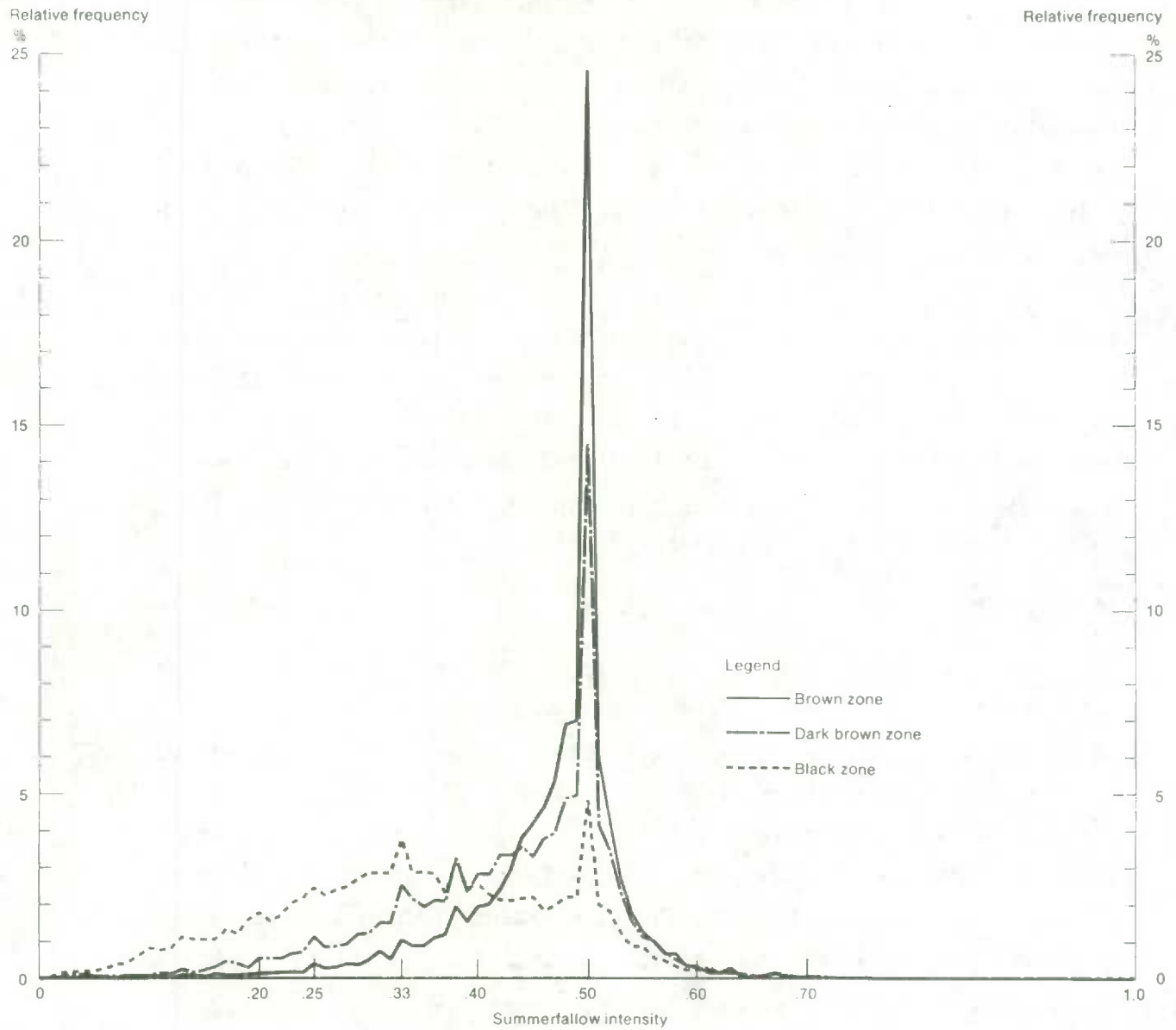
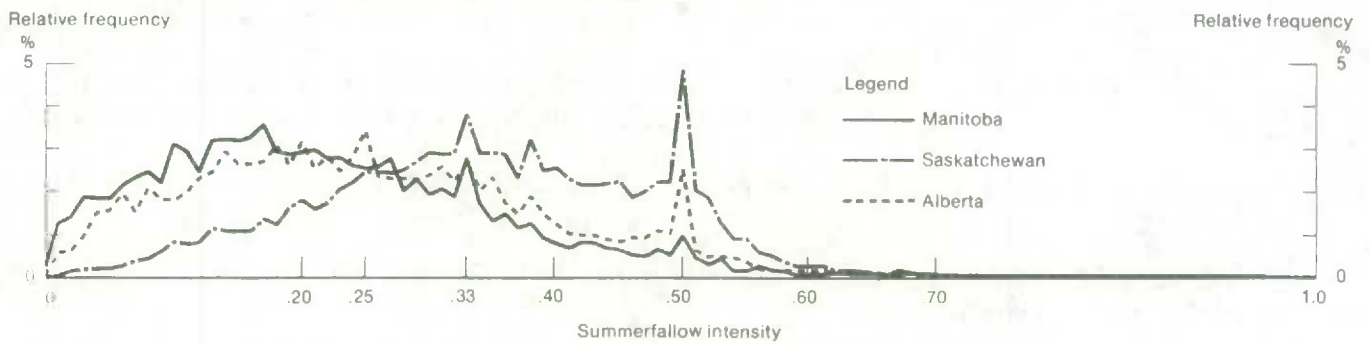


Chart — 3  
**Frequency Distributions of Summerfallow Intensity on Grain Farms in the Black Zones of Manitoba, Saskatchewan and Alberta, 1981**



these farms in the Black zone. The percentages of farms having SF intensities falling five points on either side of .50 in the Brown, Dark Brown and Black zones are respectively: 69%, 48% and 22%. Referring next to Chart 3, the most frequently reported intensities (i.e. the modes) are much less prominent. Saskatchewan intensities mode at .50 and .33. The Manitoba and Alberta distributions indicate no obvious moding. If summerfallow were fixed in individual farm rotations, there would be more distinct moding at the .50, .33, .25 and .20 intensity values.

Review of these distributions for Grain Farms in each of the four zones suggests that producers in the Black and Gray zones have more latitude regarding the position of summerfallow in crop rotations than producers in drier zones. However, in the moisture-adequate zones of Saskatchewan, summerfallow occupies a much more important position in crop rotations than in the same zones of either of the other provinces.

Interprovincial Comparison - The question at this point is: Why, after controlling for soil-climatic zone, are Saskatchewan SF intensities significantly higher than the intensities of either of the other provinces? In addressing this question, zone was refined through controlling for soil texture. Within a particular zone there are few large tracts of land in all three provinces having common texture. After soil maps were studied to identify census consolidated subdivisions having uniform soil texture, samples of subdivisions with fairly consistent Black loam morainal soils were selected in the Manitoba and in Saskatchewan Black zones<sup>1</sup>.

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<sup>1</sup> Samples of subdivisions having fairly consistent black loam morainal soils are: Manitoba: Odanah, Rapid City, Blanshard, Shoal Lake, Hamiota and Wallace.

Saskatchewan: Langenburg, Churchbridge, Fertile Belt, Grayson, Ituna Bon Accord, Foam Lake, Buchanan, Emerald and Elfros.

For subdivision locations, see maps in the census publications shown in References.

There were 560 and 1,525 Grain Farms respectively in the Manitoba and Saskatchewan samples.

Even after controlling for both soil-climatic zone and soil texture on Grain Farms in the selected subdivisions, there remains considerable difference between the Manitoba and Saskatchewan SF intensities. The intensities of the sample subdivisions in Manitoba and Saskatchewan are 0.244 and .0344 respectively while the corresponding Manitoba and Saskatchewan provincial Black-zone intensities are 0.196 and 0.330. The difference between the sample intensities is 0.100 and the difference between the two provincial Black-zone intensities is 0.134. The difference between the two sample intensities is thus reduced to three-quarters of the difference between the two province's Black-zone intensities.

Precipitation levels were much the same for all the selected subdivisions included in this comparison. Since basic soil characteristics and precipitation levels were held constant, the results imply that non-agronomic factors may be relevant. It is clear that there is a definite need for comprehensive analysis aimed at explaining inter-provincial differences in intensity.

Cross Tabulation - This statistical tool is used to indicate the extent that SF intensity varies across subgroups or categories of the nine variables to be associated with summerfallow. To facilitate analysis, no more than five categories are established for each of the variables. The specific categories for each of the variables follow.

- Cultivated Area in acres: under 450, 450-749, 750-1199, 1200-2199, 2200 and more.
- Farm Organization: individual proprietorship, partnership, family corporation, others.
- Land Tenure: wholly owned, wholly rented, partly owned and partly rented.
- Age of Operator in years: less than 30, 30-39, 40-49, 50-59, 60 and over.
- Days of Off-Farm Work by Operator: no off-farm work, 1-49, 50-99, 100-199, 200 and more.
- Fertilizer Expense/acre of cropland: no expense, \$0.01-\$4.99, \$5.00-\$9.99, \$10.00-\$14.99, \$15.00 and over.
- Agriculture Chemical Expense/acre of cropland: no expense, \$0.01-\$1.99, \$2.00-\$4.99, \$5.00-\$7.99, \$8.00 and over.

- Value of Farm Machinery/acre of cultivated land: under \$50.00, \$50.00-\$99.99, \$100.00-\$149.99, \$150.00-\$199.99, \$200.00 and over.
- Agricultural Sales: \$10,000-\$24,999, \$25,000-\$39,999, \$40,000-\$59,999, \$60,000-\$79,999, \$80,000 and over.

These categories are defined to span a variable with categories making sense agriculturally.

**Cultivated area per farm** varies considerably among zones with area generally decreasing from Brown to Dark Brown and Black and Gray zones. The size differences between the Dark Brown and Black zones are the largest. For instance, the mean cultivated area of Saskatchewan Grain Farms for the above four respective zones are 998, 916, 720 and 671 acres or 404, 371, 291 and 272 hectares (Appendix A, Table A.8). Holding zone constant, Alberta has the largest farms in the drier zones and Manitoba has the smallest farms. This variation between zones and provinces is reflected in the zonal distributions of Grain Farms distributed among the five area categories. The farm distributions in the Black and Gray zones are weighted toward the lower categories. Less than 3% of farms in the latter zones are in the highest area category (Table 6).

Cross tabulations show no change in SF intensity across the area categories in the Brown and Dark Brown zones (Table 5). In the Black and Gray zones, there is a tendency for intensity to decrease with increasing farm cultivated area. The range in intensities over the five area categories in the Black zone are 0.127 in Manitoba, 0.083 in Saskatchewan and 0.054 in Alberta (Table 6). The significance of these ranges is judged relative to (a) the inter-category distribution of farms, and (b) the percentage change in intensity. A range is deemed significantly large when each of the categories contains 5% or more of the Grain Farms in each provincial zone and when intensity changes over the relevant categories by 33% or more, based on the intensity of the first category. Returning to the Black zone example, intensity changes over the relevant categories (i.e. the first four) by 37% in Manitoba, 18% in Saskatchewan and 15% in Alberta. The Manitoba Black zone is the only provincial zone where there is significant variation.<sup>1</sup>

<sup>1</sup> The per cent change in the Manitoba Gray zone is 29%.



Table 5. SF Intensities on Saskatchewan Grain Farms by Size of Farm in Cultivated Acres and by Soil-Climatic Zone, 1981

Size of Farm	Brown	Dark Brown	Black	Gray
Under 450 Acres				
Farms	1,331	2,464	4,538	1,614
Intensity	0.462	0.428	0.367	0.326
450-749 Acres				
Farms	2,309	3,773	4,884	1,560
Intensity	0.466	0.428	0.346	0.294
750-1,199 Acres				
Farms	2,777	4,177	3,302	937
Intensity	0.465	0.430	0.332	0.275
1,200-2,199 Acres				
Farms	2,046	2,552	1,442	374
Intensity	0.466	0.424	0.302	0.243
2,200 & More Acres				
Farms	461	522	293	76
Intensity	0.457	0.409	0.284	0.215
Total				
Farms	8,924	13,488	14,459	4,561
Intensity	0.464	0.425	0.330	0.279

Table 6. SF Intensities on Grain Farms in the Black Zone, by Size of Farm and Province, 1981

Size of Farm	Manitoba	Saskatchewan	Alberta
Under 450 Acres			
Farms	2,287	4,538	1,846
Intensity	0.250	0.367	0.269
450-749 Acres			
Farms	1,902	4,884	1,406
Intensity	0.211	0.346	0.253
750-1,199 Acres			
Farms	1,104	3,302	947
Intensity	0.191	0.332	0.236
1,200-2,199 Acres			
Farms	468	1,442	518
Intensity	0.158	0.302	0.229
2,200 & More Acres			
Farms	107	293	129
Intensity	0.123	0.284	0.215
Total			
Farms	5,868	14,459	4,846
Intensity	0.196	0.330	0.241

Source: 1981 Census of Agriculture

The SF intensity in the Black and Gray zones of all these provinces consistently decrease with increasing cultivated area. It may thus be tentatively concluded that, in the moisture-adequate zones, there is a small tendency for larger grain operations to have lower intensities. This contrasts with the widespread notion that larger operations farm more extensively and use more summerfallow than smaller farms. From the broad regional standpoint this is correct since farms in drier zones generally have more cultivated area and have higher intensities.

The analysis detects no significant variation in SF intensity according to **legal farm organization**. Ninety-nine per cent of Grain Farms are either individual proprietorships, partnerships, or family corporations. Proprietorship is the prevalent form of organization representing 88.1% of prairie Grain Farms, partnerships come next 8.4% and family corporations at 3.2%. These percentages are much the same in different zones. Comparing the zonal intensities of the three principal forms of organization, there is some variation in the Black and Gray zones. Within these zones, proprietorships have a slightly higher intensity than partnerships and partnerships are modestly higher in intensity than family corporations. The most intensity variation occurs in the Manitoba Black zone where the intensities of proprietorships and family corporations are respectively 0.208 and 0.125. Since less than 5% of farms are in the corporations category, the percentage difference in intensity over these categories is non-significant. There is no question, however, that there is a consistent downward trend from proprietorships to partnerships to family corporations (Appendices B and C, Tables B.2 and C.2).

There are few a priori grounds for anticipating that **land tenure** has a significant effect on SF intensity. One might hypothesize that farmers who own their farms are more conscious of the long-term costs of summerfallow and are therefore less inclined to fallow. On the other hand, tenants may be less disposed to summerfallow because they are more intent on cropping and less willing to sustain the opportunity costs of fallow, especially where there is sufficient moisture. As well, farmers who rent annually may behave altogether

differently than those who rent for a longer duration. Limited documentation on common tenure arrangements in prairie agriculture exists to use as a guide in formulating hypotheses about which forms of tenure have lower or higher intensity.

Examination of tenure data indicates no significant association between tenure and SF intensity. There are three categories: owned, rented and partly owned and partly rented. Comparing intensity levels across the three tenure categories shows no change in the Brown and Dark Brown zones. In the other zones, intensity consistently decreases from owned to rented farms to partly-owned and partly-rented farms (Appendices B and C, Tables B.3 and C.3). The main comparison is between owned and partly-owned and partly-rented farms because rented farms account for less than a tenth of the farms in any provincial zone and because both of the former categories usually contain 45% or more of the farms in a provincial zone. The most intensity change between these two forms of tenure is in the Manitoba Black zone where the intensity for partly-owned and partly-rented farms is 24% lower than for owned farms.

**Age of operator** is widely believed to be a key factor affecting farmers' orientation to fallow. The underlying reasoning is: younger farmers have more years of formal education, higher debt loads, and are less influenced by traditional practices than older farmers; therefore younger farmers are engaged in more intensive grain production and use less summerfallow. Cross tabulations provide limited empirical support for this hypothesis. SF intensity remains stable in the Brown and Dark Brown zones while the extent of intensity change in the other zones falls short of significant magnitude. Only in Manitoba Black zone is the inter-category intensity range significant (41%) (Tables 7 and 8 ). The data nonetheless exhibit a direct relation between the two variables that is somewhat inconsistent. Frequently, the intensity of the second age category is slightly lower than in the first category. As well, the intensity increase of the "60 and more years" category is often almost as large as the increase over the first four categories. In summary, while there is visible direct association between age and intensity in zones where farmers are relatively unfettered by moisture conditions, the overall extent of association is not nearly as marked as is commonly believed.

Table 7. SF Intensities on Saskatchewan Grain Farms by Age of Operator and by Soil-Climatic Zone, 1981

Age Categories	Brown	Dark Brown	Black	Gray
Under 30 Years				
Farms	1,694	2,134	1,980	575
Intensity	0.464	0.422	0.310	0.260
30-39 Years				
Farms	1,670	2,572	3,037	946
Intensity	0.461	0.415	0.306	0.260
40-49 Years				
Farms	1,608	2,578	3,070	1,074
Intensity	0.462	0.419	0.332	0.279
50-59 Years				
Farms	2,223	3,365	3,666	1,188
Intensity	0.465	0.431	0.340	0.287
60 & More Years				
Farms	1,729	2,839	2,706	778
Intensity	0.469	0.439	0.371	0.323
Total				
Farms	8,924	13,488	14,459	4,561
Intensity	0.464	0.425	0.330	0.279

Table 8. SF Intensities on Grain Farms in the Black Zone, by Age of Operator and Province, 1981

Age Categories	Manitoba	Saskatchewan	Alberta
Under 30 Years			
Farms	828	1,980	568
Intensity	0.171	0.310	0.212
30-39 Years			
Farms	1,246	3,037	914
Intensity	0.180	0.306	0.221
40-49 Years			
Farms	1,117	3,070	1,076
Intensity	0.188	0.332	0.232
50-59 Years			
Farms	1,569	3,666	1,293
Intensity	0.208	0.340	0.258
60 & More Years			
Farms	1,108	2,706	995
Intensity	0.241	0.371	0.277
Total			
Farms	5,868	14,459	4,846
Intensity	0.196	0.330	0.241

Source: 1981 Census of Agriculture



There are grounds for expecting that there is a direct relation between number of **days of off-farm work** and SF intensity. Farmers with more remunerative or more stable off-farm earnings may substitute on-farm labour for off-farm labour by increasing summerfallow area and farming more extensively. Somewhat surprisingly, cross tabulations indicate no association between the two variables (Appendices B and C, Tables B.5 and C.5).

**Machinery, fertilizer and agriculture chemicals** underlie intensive grain production. It is anticipated that higher physical capital intensity as well as higher fertilizer and chemical expenses are closely associated with lower summerfallow intensity. Under the climatic conditions of prairie agriculture there is limited time available for seeding and harvesting operations. Machinery intensive farmers can crop a larger proportion of their cultivated land than those with less machinery. Also, as mentioned earlier, fundamental reasons for using summerfallow, besides to conserve moisture, are to regenerate soil fertility over the short term and to control weeds. Fertilizer and herbicides (ag chemicals)<sup>1</sup> may be considered as substitutes for summerfallow in areas where moisture is adequate.

Fertilizer expense is more associated with SF intensity than ag chemical expense and machinery value. Intensity variation is again mainly confined to the Black and Gray zones where intensity consistently declines with higher input values. The intensity ranges over categories, expressed as percentages, are as follows in the Black zones:

	<u>Fertilizer Expense</u>	<u>Ag Chemical Expense</u>	<u>Machinery Value</u>
Manitoba	46%	28%	25%
Saskatchewan	34%	15%	18%
Alberta	35%	19%	30%

It is evident that the fertilizer percentages are the highest and that intensity varies over the fertilizer categories by more than a third. Similar percentages in the Gray zone are in most cases slightly lower. Interestingly,

<sup>1</sup> A large proportion of grain farmers' ag chemical bill is for herbicides. The proportion is highest for farmers growing cereal crops and decreases with greater orientation toward alternative crops which are subject to a wider range of pests.

similar percentages for fertilizer in the Dark Brown zones of Saskatchewan and Alberta are 20% and 34% respectively. Relative to the other variables, intensity changes much more across the fertilizer categories of the Dark Brown zone.

A notable proportion of grain farmers reported no fertilizer or chemical expense on the 1981 census questionnaire. Twelve per cent of prairie Grain Farms reported neither fertilizer nor chemical expenses while 43% reported either no fertilizer or no chemical expense. These percentages are quite consistent with the established pattern in that Grain Farms in the moisture-deficit areas have definitely higher percentages than farms in moisture-adequate areas. Superimposed on this pattern is a tendency for nonexpenditure of fertilizer to be more extensive than of chemicals in the drier zones. For example, 58% of Saskatchewan Wheat Farms in the Brown zone had no fertilizer expense, and the respective chemical percentage is 27%. The difference in these percentages largely disappears in the moisture-adequate zones. A better idea of how non-expenditure varies by zone and province may be obtained from the cross tabulations in Tables 9 to 12.

Considering all values reported for fertilizer and chemical expenses, the lowest expenses are generally in the Brown zone and the highest expenses are in the Black and Gray zones. There is a clear inverse relation between mean expense and mean SF intensity (Appendix A. Table A.8). These data may simply reflect prevailing moisture regimes. Moisture is closely related to fertilizer and chemical usage because moisture acts as a transfer medium for soil nutrients and moisture determines yield potential. Moisture, however, does not explain why Saskatchewan farmers in the non-Brown zones have lower mean expenses than farmers in the same zones of the other provinces.

Unlike the input variables, there are few reasons for anticipating a distinct relationship between **gross farm sales** and SF intensity. A reading of the cross tabulations indicates very slight variation in the Brown and Dark Brown zones. A more obvious relation emerges in the Black and Gray zones where the intensity range varies by 49% in the Manitoba Black zone and by 26% and 30%

Table 9. SF Intensities on Saskatchewan Grain Farms by Fertilizer Expense/Cropland Acre and by Soil-Climatic Zone, 1981

Fertilizer Expense	Brown	Dark Brown	Black	Gray
No Expense Farms	5,190	6,031	4,021	666
Intensity	0.475	0.452	0.394	0.330
\$0.01-\$4.99 Farms	2,099	3,148	3,180	920
Intensity	0.456	0.424	0.339	0.300
\$5.00-\$9.99 Farms	1,202	2,597	3,616	1,313
Intensity	0.452	0.413	0.328	0.298
\$10.00-\$14.99 Farms	286	995	1,901	769
Intensity	0.431	0.380	0.290	0.255
\$15.00 & More Farms	147	717	1,741	893
Intensity	0.447	0.363	0.262	0.234
Total Farms	8,924	13,488	14,459	4,561
Intensity	0.464	0.425	0.330	0.279

Table 10. SF Intensities on Grain Farms in the Black Zone, by Fertilizer Expense/Cropland Acre and by Province, 1981

Fertilizer Expenses	Manitoba	Saskatchewan	Alberta
No Expense Farms	719	4,021	485
Intensity	0.287	0.394	0.299
\$0.01-\$4.99 Farms	759	3,180	605
Intensity	0.245	0.339	0.284
\$5.00-\$9.99 Farms	1,285	3,616	1,290
Intensity	0.219	0.328	0.277
\$10.00-\$14.99 Farms	1,208	1,901	1,090
Intensity	0.183	0.290	0.226
\$15.00 & More Farms	1,897	1,741	1,376
Intensity	0.155	0.262	0.194
Total Farms	5,868	14,459	4,846
Intensity	0.196	0.330	0.241

Source: 1981 Census of Agriculture

Table 11. SF Intensities on Saskatchewan Grain Farms by Ag. Chemical Expense/Cropland Acre and by Soil-Climatic Zone, 1981

Ag. Chemical Expense	Brown	Dark Brown	Black	Gray
No Expense Farms	2,386	3,580	3,596	731
Intensity	0.470	0.435	0.371	0.310
\$0.01-\$1.99 Farms	3,343	3,638	2,943	1,015
Intensity	0.462	0.429	0.334	0.285
\$2.00-\$4.99 Farms	2,030	3,276	3,539	1,264
Intensity	0.463	0.416	0.318	0.279
\$5.00-\$7.99 Farms	722	1,759	2,402	819
Intensity	0.459	0.418	0.311	0.270
\$8.00 & More Farms	443	1,235	1,979	732
Intensity	0.465	0.423	0.315	0.257
Total Farms	8,924	13,488	14,459	4,561
Intensity	0.464	0.425	0.330	0.279

Table 12. SF Intensities on Grain Farms in the Black Zone, by Ag. Chemical Expense/Cropland Acre and by Province, 1981

Ag. Chemical Expense	Manitoba	Saskatchewan	Alberta
No Expense Farms	885	3,596	580
Intensity	0.247	0.371	0.271
\$0.01-\$1.99 Farms	1,055	2,943	917
Intensity	0.220	0.334	0.251
\$2.00-\$4.99 Farms	1,465	3,539	1,475
Intensity	0.189	0.318	0.240
\$5.00-\$7.99 Farms	1,093	2,402	994
Intensity	0.178	0.311	0.239
\$8.00 & More Farms	1,370	1,979	880
Intensity	0.178	0.315	0.220
Total Farms	5,868	14,459	4,846
Intensity	0.196	0.330	0.241

Source: 1981 Census of Agriculture



in the corresponding Saskatchewan and Alberta Black zones. The percentages were much the same in the Gray provincial zones except that in Saskatchewan the percentage just exceeds 33% (Appendices B and C, Tables B.9 and C.9). The importance of the sales variable is overshadowed by the suspicion that the impact of sales on intensity is intertwined with the area and input variables. For a particular zone, sales revenue is largely derived from farm cultivated area, management practices and yields. The sales variable is of interest, nevertheless, because it is presently employed as an administrative variable in crop insurance programs and may be considered as an administrative variable in other programs affecting grain farms.

Correlation - A limitation encountered in cross tabulation is establishing a common set of categories which are equally applicable for all zones.

Comparison of SF intensities between zones may be limited by the distribution of farms among categories. For example, in the case of fertilizer expense, a large proportion of Grain Farms in the Brown zone are concentrated in the bottom three categories of fertilizer expense whereas Grain Farms located in the Black zone are more evenly distributed among fertilizer expense categories. The range in intensities across fertilizer categories in the Brown zone is therefore not readily comparable with the range in the Black zone. To eliminate the inter-category distribution of farms as a source of distortion, correlation is employed in the analysis of continuous data. Correlation measures the degree of association between variables and, in this application, is based on individual farm (micro) data.

Despite cross tabulation indicating a general tendency in the Black and Gray zones for SF intensity<sup>1</sup> to be associated with farm cultivated area, operator age, fertilizer and ag chemical expense, machinery value and ag sales, correlation of micro data reveals little covariability between intensity and any of the variables. A rule of thumb in interpreting the size of correlation coefficients, which can range from +1.00 to -1.00, is that an absolute value of less than 0.40 indicates minor covariability. Correlation coefficients in the Black zone range from +0.17 to -0.29 (Table 13) but are usually

<sup>1</sup> It may be recalled that the intensity definition for cross tabulation purposes is the ratio of total SF area to total cultivated area in each table cell. This definition averages out farm-to-farm variation and cross tabulation results are thus indicative of general tendency.

Table 13. Simple Correlation Coefficients Between SF Intensity and Selected Variables, Grain Farms in the Black Zone, 1981

Province & Zone	Cultivated Area	Age of Operator	Fertilizer Expense/ Unit of Cropland	Chemical Expense/ Unit of Cropland	Machinery Value/Unit of Cultivated land	Total Sales
<u>Manitoba Black Zone</u>	- 0.23	+ 0.17	- 0.19	- 0.04*	- 0.09	- 0.29
<u>Saskatchewan Black Zone</u>	- 0.16	+ 0.17	- 0.07	+ 0.02*	- 0.10	- 0.24
<u>Alberta Black Zone</u>	- 0.10	+ 0.17	- 0.19	- 0.06	- 0.15	- 0.20
<u>Prairie Black Zone</u>	- 0.13	+ 0.15	- 0.17	- 0.03	- 0.15	- 0.24

Note: All coefficients except those denoted by an asterisk are significant at the .0001 probability level.

statistically significant (i.e. significantly different than zero). The signs (+ or -) of the coefficients are usually consistent with the cross tab results in that there is positive association between age and intensity and negative association between intensity and most other variables.

Inspection of correlation matrices (Appendix D) indicates that most non-intensity variables vary independently of each other. Farm cultivated area and ag sales are the only variables that are highly correlated in terms of both the magnitude of coefficients and statistical significance. Coefficients linking fertilizer and chemical expenses are relatively high but, in some cases, fall short of the .40 threshold.

Correlation analysis discloses wide farm-to-farm variation in the data. Some of the variation is due to generalizations made in operationally defining farm type and soil-climatic zone. Also, some variation is attributable to (a) the expense variables not pertaining specifically to nitrogen and herbicide expense, and (b) the financial data pertaining to 1980 rather than 1981. Between 1980 and 1981, ag chemical expenses in the Prairie Provinces increased by about 39% (STC, 1983).

No-fallow Farms - Finally, 1981 census data are briefly analyzed to identify marked differences between farms with and without summerfallow. To maintain comparability with the past discussion, no-fallow farms are defined as all census farms in the Prairie Provinces having zero SF area, ag sales equal to or greater than \$10,000 and no irrigation system. In addition, previous definitions of cropland, cultivated land, farm type and the nine variables are retained.

No-fallow farms, irrespective of farm type, contain 10.2 million acres (4.1 million hectares) of cropland (Table 14). Comparing soil-climatic zones, ninety per cent of cropland on no-fallow farms is in the Black and Gray zones. Consistent with the previous findings, the movement toward dropping summerfallow from the rotation appears to be most advanced in the Black and

Table 14. Area Seeded to Annual Field Crops<sup>1</sup> on Non-irrigated Farms with Agricultural Sales Greater or Equal to \$10,000 and Having No Summerfallow, 1981.

Zone	Units	Area Seeded to Annual Field Crops <sup>1</sup>	%	% of Total Annual Field Crop Area <sup>1</sup> on Farms <sup>2</sup> in Zone(s)
<u>Manitoba</u>				
Black & Gray	ac	3,985,085	38.9	44.4
	ha	1 612 707		
<u>Saskatchewan</u>				
Brown	ac	170,505	1.7	3.2
	ha	69 001		
Dark Brown	ac	353,261	3.4	4.3
	ha	142 960		
Black & Gray	ac	1,213,577	11.9	10.2
	ha	491 117		
<u>Alberta</u>				
Brown	ac	114,477	1.1	6.3
	ha	46 327		
Dark Brown	ac	373,807	3.7	15.2
	ha	151 274		
Black & Gray	ac	4,018,709	39.3	39.1
	ha	1 626 314		
<u>Prairie Provinces</u>				
Brown	ac	284,982	2.8	4.0
	ha	115 328		
Dark Brown	ac	727,068	7.1	6.9
	ha	294 234		
Black & Gray	ac	9,217,371	90.1	29.7
	ha	3 730 138		
<u>Total</u>	ac	10,229,421	100.0	20.9
	ha	4 139 700		

<sup>1</sup> Field crop area minus perennial forage area

<sup>2</sup> Farms with no irrigation system and agricultural sales greater or equal to \$10,000 in 1980.

Source: 1981 Census of Agriculture



Gray zones of Manitoba and Alberta, with Saskatchewan significantly lagging. Within the Black and Gray zones, no-fallow farms account for 44% of total cropland on all Manitoba farms with ag sales equal to or greater than \$10,000 and with no irrigation system. Similar percentages in the Black zones of Alberta and Saskatchewan are 39% and 10% respectively. Within the Dark Brown zones of the latter two provinces, a definitely lower proportion of cropland is on Saskatchewan no-fallow farms than on like farms in Alberta.

In 1981, there were 13,048 no-fallow **grain** farms in the Prairie Provinces. A number of contrasts are detected between no-fallow grain farms and Grain Farms. The most significant differences concern cultivated area, fertilizer and ag chemical expenses. No-fallow grain farms are somewhat smaller in cultivated area even though the previous cross tabulations indicate that SF intensity decreases modestly with increasing cultivated area per farm. More in line with the cross tab results, no-fallow grain farms have higher fertilizer and ag chemical expenses per unit of cropland. For example in the Manitoba Black zone, no-fallow grain farms have mean fertilizer expenses 42% greater and mean ag chemical expenses 28% greater than Grain Farms in this zone. There is also some tendency for operators of no-fallow farms to be younger, to rent more cropland and to have higher ag sales. Thus, with the exception of cultivated area, these comparisons reinforce the findings of the cross-tab portion of this section.

More detailed study of no-fallow farms is outside the scope of this paper as the objective was to carry out a cross-sectional analysis of farms similar with respect to farm type and orientation toward summerfallow. The relevant sub-population of farms might be broadened to include all farms with some cultivated land and with no summerfallow. Further research could be designed to trace farms' SF intensities between censuses to better understand the process of how farms shift out of fallow completely. Such research might also examine the impact of farm commodity diversification on intensity. Agricultural production in Manitoba and Alberta is generally more diversified than in Saskatchewan and this may be related to SF reduction and the eventual elimination of fallow from the rotation.

## Summary

The findings document that prairie producers' propensity to fallow varies significantly by province and soil zone. Levels of summerfallow intensity decrease with movement from Brown to Dark Brown to Black and Gray zones. Within given soil zones, provincial intensity levels distinctly fall from Saskatchewan to Alberta to Manitoba.

Data from the 1976 and 1981 censuses indicate that total summerfallow area in the Prairies is declining. The extent of decline again varies according to soil zone and province. A large portion of the reduction has been in the Black and Gray zones. In the Dark Brown zone, there has been a much smaller decrease in summerfallow area while, in the Brown zone, this area has increased marginally. Among provinces, the summerfallow phenomenon is most persistent in Saskatchewan which accounts for more than 70% of total prairie land in fallow. On a zonal basis, the percentage decrease in summerfallow area is lowest in Saskatchewan. This is most evident in the Saskatchewan Dark Brown zone where summerfallow area fell by only 2.8% compared to 15.9% in the Alberta Dark Brown zone.

The special nature of the summerfallow practice in Saskatchewan is underlined by comparisons of (a) frequency distributions of summerfallow intensities of individual farms, (b) intensities in selected census subdivisions with uniform soil zone and soil texture, and (c) data on farms not using summerfallow.

Cross tabulations of 1981 data show that summerfallow intensity is fairly unresponsive in the Brown and Dark Brown zones to change in the variables discussed. However, in the Black and Gray zones, general tendencies are detected which are significant in terms of consistency but are often small in magnitude. Intensities in the moisture-adequate zones trend upward with increasing operator age and consistently trend downward with increasing cultivated area, ag chemical expenses per acre, machinery value per acre and gross farm sales. For fertilizer expenses, trends in intensities are not only consistent but are significant in magnitude. Yet, when seeking to verify

these cross-tabulation results via linear correlation of individual farm data, there is limited covariation between intensity and each of the variables. Most correlation coefficients are significantly different than zero however. The relatively low coefficients reflect a lot of farm-to-farm variation.

Profiling farmers using summerfallow is no easy task. Past research has similarly encountered difficulty in identifying well defined relationships in the data. One response is to attribute unexplained variation to farmer attitudes and tradition, thereby suggesting a non-rational basis for summer-fallow. However, at this stage in the development of the primary grains sector, it seems quite realistic to downplay the role of tradition, etc. and to consider other variables that may clarify relationships (e.g. soil texture, risk aversion and debt load).

Due to the importance of summerfallow reduction in contributing toward the long-term viability of the grains sector, further research will be required. There is no question of the need for ongoing research on the development and application of moisture enhancing technologies. This paper's results suggest that moisture considerations override other factors in the Brown and Dark Brown zones. Socio-economic research would therefore best concentrate on other zones where moisture poses little constraint.

The exploratory analysis outlined here certainly does not exhaust the usefulness of census data in the study of summerfallow. Additional work, for example, could be designed to examine the trend in summerfallow between census years, to make more detailed comparison of farms with and without summerfallow, and to include other variables. Data for the 1981 agriculture and population censuses have recently been computer-linked enabling the inclusion of socio-economic variables (e.g. ethnicity, years of formal education, and unpaid family labour). Moreover, information from a number of other databases can be used to complement census data.



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Appendix A

Background Statistics

Table A.1 Distribution of SF Area Among Grain Farms and Other Census Farms, Prairie Provinces, 1981

	Units	SF Area	%
Grain Farms	ac ha	18,040,758 7 300 835	76.8
Other Dryland Farms with Agricultural Sales $\geq$ \$10,000 <sup>1</sup>	ac ha	3,143,184 1 272 001	13.4
Irrigated Farms with Agricultural Sales $\geq$ \$10,000	ac ha	882,706 357 219	3.7
Farms with Agricultural Sales < \$10,000	ac ha	1,428,803 578 216	6.1
Total Prairies	ac ha	23,495,451 9 508 272	100.0

<sup>1</sup> Other farm types besides wheat and small grain farms.

Source: 1981 Census of Agriculture.

Table A.2 Total SF and Cropland Area on Census Farms, Prairie Provinces, 1921 - 1981.

Year	Units	SF Area	All Cropland Area*	Ratio of Summerfallow to Cropland Area*
1921	ac	11,274,650	32,199,892	0.35
	ha	4 562 688	13 030 832	
1931	ac	16,558,488	40,014,292	0.41
	ha	6 700 982	16 193 207	
1941	ac	23,116,354	38,379,431	0.60
	ha	9 354 856	15 531 603	
1951	ac	21,569,634	45,468,390	0.47
	ha	8 728 921	18 400 402	
1956	ac	24,112,283	47,016,685	0.51
	ha	9 757 893	19 026 975	
1961	ac	27,859,425	47,226,759	0.59
	ha	11 274 308	19 111 988	
1966	ac	25,223,780	51,953,903	0.49
	ha	10 207 700	21 024 996	
1971	ac	26,223,736	54,554,165	0.48
	ha	10 612 369	22 077 285	
1976	ac	26,561,275	54,580,405	0.49
	ha	10 748 965	22 087 904	
1981	ac	23,495,451	60,794,046	0.39
	ha	9 508 270	24 602 475	

\* Including cropland in fruits and vegetables, tame hay, etc.

Source: Various census publications.

Table A.3 SF area on Census Farms by Agricultural Sales and by Province, 1981

Agricultural Sales	Units	Manitoba	Saskatchewan	Alberta	Total Prairies
\$250,000 and over	ac	52,397	554,569	535,835	1,142,801
	ha	21 204	224 426	216 845	462,475
	No	247	511	775	1,533
\$100,000 - 249,999	ac	180,037	2,802,449	1,244,849	4,227,335
	ha	72 858	1 134 111	503 772	1,710,741
	No	1,155	4,644	3,123	8,922
\$50,000 - 99,999	ac	375,505	5,661,356	1,525,999	7,562,860
	ha	151 961	2 291 069	617 550	3,060,580
	No	2,840	14,286	5,947	23,073
\$25,000 - 49,999	ac	405,521	4,534,574	1,082,296	6,022,391
	ha	164 109	1 835 077	437 990	2,437,176
	No	3,696	17,409	6,369	27,474
\$10,000 - 24,999	ac	294,818	2,181,363	635,080	3,111,261
	ha	119 309	882 766	257 008	1,259,083
	No	3,443	13,288	6,002	22,733
Less than \$10,000	ac	170,248	832,783	425,772	1,428,803
	ha	68 897	337 016	172 304	578,217
	No	3,045	7,747	5,629	16,421
Total	ac	1,478,526	16,567,094	5,449,831	23,495,451
	ha	598 338	6 704 465	2 205 469	9,508,272
	No	14,426	57,885	27,845	100,156

Source: 1981 Census of Agriculture publications, Table 29 (see References).

Table A.4 SF Area on Census Farms with Sales of \$2,500 or more, by Farm Type and by Province, 1981

Farm Type	Units	Manitoba	Saskatchewan	Alberta	Total Prairies
Wheat Specialty	ac	464,319	12,678,945	2,044,850	15,188,114
	ha	187 903	5 130 986	827 521	6,146,410
	No	3,904	38,429	5,847	48,180
Small Grain (Excluding wheat specialty farms)	ac	540,464	1,904,377	1,859,969	4,304,810
	ha	218 718	770 674	752 703	1,742,095
	No	4,591	8,702	10,488	23,781
Cattle	ac	216,027	934,787	805,852	1,956,666
	ha	87 423	378 295	326 117	791,835
	No	2,511	5,067	5,514	13,092
Dairy	ac	46,858	224,252	87,574	358,684
	ha	18 963	90 752	35 440	145,155
	No	636	1,201	900	2,737
Hogs	ac	35,151	71,472	49,189	155,812
	ha	14 225	28 924	19 906	63,055
	No	420	411	540	1,371
Poultry	ac	7,188	14,056	15,048	36,292
	ha	2 909	5 688	6 090	14,687
	No	127	98	157	382
Field Crops (Other than small grain specialty farms)	ac	10,975	9,216	30,255	50,446
	ha	4 441	3 730	12 244	20,415
	No	142	85	345	572
Fruit and Vegetables	ac	1,528	628	886	3,042
	ha	618	254	359	1,231
	No	46	13	31	90

Table A.4 SF Area on Census Farms with Sales of \$2,500 or more, by Farm Type and by Province, 1981 (Continued)

Farm Type	Units	Manitoba	Saskatchewan	Alberta	Total Prairies
Miscellaneous Specialty	ac	3,747	11,761	14,438	29,946
	ha	1 516	4 760	5 843	12,119
	No	79	82	196	357
<u>Mixed Farms</u>					
Livestock Combination	ac	75,823	384,818	308,076	768,717
	ha	30 684	155 730	124 674	311,088
	No	753	1,522	1,477	3,752
Field Crop Combination	ac	3,948	1,671	9,822	15,441
	ha	1 598	676	3 975	6,249
	No	42	10	64	116
Other Combinations	ac	33,519	201,262	108,969	343,750
	ha	13 565	81 448	44 098	139,111
	No	325	827	539	1,691
Total	ac	1,439,547	16,437,245	5,334,928	23,211,720
	ha	582 564	6 651 916	2 158 969	9,393,449
	No	13,576	56,447	26,098	96,121

Note: Farm-type definitions are given in Lennox.

Source: 1981 Census of Agriculture publications, Table 30 (see References).



Table A.5 Summerfallow and Cultivated Areas on Census Farms, by Province and Soil-Climatic Zone, 1976 and 1981

Province & Zone	Units	1976	1981
<u>Manitoba</u>			
Black - SF Area	ac	1,895,588	1,163,610
	ha	767 117	470 896
- Cultivated Area	ac	8,968,380	9,543,014
	ha	3 629 374	3 861 920
Gray - SF Area	ac	412,617	314,916
	ha	166 980	127 442
- Cultivated Area	ac	1,414,924	1,594,711
	ha	572 599	645 357
<u>Saskatchewan</u>			
Brown - SF Area	ac	4,909,298	4,931,575
	ha	1 986 722	1 995 737
- Cultivated Area	ac	10,481,399	10,825,916
	ha	4 241 671	4 381 092
Dark Brown - SF Area	ac	6,257,122	6,098,720
	ha	2 532 167	2 468 064
- Cultivated Area	ac	14,286,392	14,762,415
	ha	5 781 497	5 974 137
Black - SF Area	ac	5,125,255	4,396,790
	ha	2 074 117	1 779 318
- Cultivated Area	ac	13,049,682	13,911,026
	ha	5 281 018	5 629 592
Gray - SF Area	ac	1,466,933	1,140,009
	ha	593 647	461 345
- Cultivated Area	ac	3,962,782	4,332,780
	ha	1 603 681	1 753 414
<u>Alberta</u>			
Brown - SF Area	ac	1,646,863	1,692,337
	ha	666 462	684 864
- Cultivated Area	ac	4,058,816	4,407,655
	ha	1 642 544	1 783 715
Dark Brown - SF Area	ac	1,540,563	1,296,233
	ha	623 444	524 567
- Cultivated Area	ac	4,259,043	4,422,728
	ha	1 723 573	1 789 814

Table A.5 Summerfallow and Cultivated Areas on Census Farms, by Province and Soil-Climatic Zone, 1976 and 1981 (Continued)

Province & Zone	Units	1976	1981
<u>Alberta</u>			
Black - SF Area	ac	1,924,545	1,332,818
	ha	778 836	539 372
- Cultivated Area	ac	7,820,045	8,308,574
	ha	3 164 660	3 362 360
Gray - SF Area	ac	1,382,491	1,128,443
	ha	559 474	456 665
- Cultivated Area	ac	5,369,976	5,674,549
	ha	2 173 152	2 296 408
<u>Total Prairie Provinces</u>			
Brown - SF Area	ac	6,556,161	6,623,912
	ha	2 653 184	2 680 601
- Cultivated Area	ac	14,540,215	15,233,571
	ha	5 884 215	6 164 807
Dark Brown - SF Area	ac	7,797,685	7,394,953
	ha	3 155 611	2 992 631
- Cultivated Area	ac	18,545,435	19,185,143
	ha	7 505 070	7 763 951
Black - SF Area	ac	8,945,388	6,893,218
	ha	3 620 070	2 789 586
- Cultivated Area	ac	29,838,107	31,762,614
	ha	12 075 052	12 853 872
Gray - SF Area	ac	3,262,041	2,583,368
	ha	1 320 101	1 045 452
- Cultivated Area	ac	10,747,682	11,602,040
	ha	4 349 432	4 695 179
<u>Grand Total - SF Area</u>	ac	26,561,275	23,495,451
	ha	10 748 966	9 508 270
- Cultivated Area	ac	73,671,439	77,783,368
	ha	29 813 770	31 477 809

Sources: 1976 and 1981 Censuses of Agriculture

Table A.6 SF Areas on Grain Farms by Farm Type and Soil-Climatic Zone, 1981

Province & Zone	Units	Wheat Farms	Small Grain Farms	Grain Farms
<u>Manitoba</u>				
Black	ac	330,938	421,408	752,346
	ha	133 926	170 538	304 464
Gray	ac	79,499	84,501	164,000
	ha	32 172	34 196	66 368
<u>Saskatchewan</u>				
Brown	ac	4,022,825	110,173	4,132,998
	ha	1 627 979	44 585	1 672 564
Dark Brown	ac	4,926,706	322,010	5,248,716
	ha	1 993 767	130 313	2 124 080
Black	ac	2,494,356	942,285	3,436,641
	ha	1 009 430	381 329	1 390 759
Gray	ac	436,295	417,644	853,939
	ha	176 562	169 015	345 577
<u>Alberta</u>				
Brown	ac	921,760	139,937	1,061,697
	ha	373 023	56 630	429 653
Dark Brown	ac	514,063	346,517	860,580
	ha	208 034	140 230	348 264
Black	ac	261,833	580,111	841,944
	ha	105 960	234 763	340 723
Gray	ac	119,431	568,466	687,897
	ha	48 332	230 050	278 382
<u>Total Prairies</u>	ac	14,107,706	3,933,052	18,040,758
	ha	5 709 185	1 591 649	7 300 834

Source: 1981 Census of Agriculture.

Table A.7 Numbers of Grain Farms by Farm Type and Soil-Climatic Zone, 1981

Province & Zone	Wheat Farms	Small Grain Farms	Grain Farms
<u>Manitoba</u>			
Black	2,437	3,431	5,868
Gray	620	620	1,240
<u>Saskatchewan</u>			
Brown	8,628	296	8,924
Dark Brown	12,481	1,007	13,488
Black	10,218	4,241	14,459
Gray	2,309	2,252	4,561
<u>Alberta</u>			
Brown	1,618	292	1,910
Dark Brown	1,245	1,008	2,253
Black	1,238	3,608	4,846
Gray	611	3,676	4,287
<u>Total Prairies</u>	41,405	20,431	61,836

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Source: 1981 Census of Agriculture.

Table A.8 Mean and Median Values Based on Individual Grain Farm Data, Selected Variables, by Province and Zone, 1981 Census of Agriculture

Province & Zone		Summerfallow Intensity	Cultivated Area in Acres	Operator Age	Gross Ag Sales
<u>Manitoba</u>					
Black	Mean	0.219	655	48.3	\$54,152
	Median	0.201	525	49.0	\$38,832
Gray	Mean	0.273	542	48.5	\$43,256
	Median	0.253	413	49.0	\$27,689
<u>Saskatchewan</u>					
Brown	Mean	0.465	998	47.5	\$56,412
	Median	0.488	854	49.0	\$45,629
Dark Brown	Mean	0.427	916	48.5	\$53,355
	Median	0.453	788	49.0	\$42,000
Black	Mean	0.345	720	48.2	\$48,259
	Median	0.345	600	49.0	\$35,000
Gray	Mean	0.298	671	48.1	\$49,106
	Median	0.294	555	49.0	\$35,000
<u>Alberta</u>					
Brown	Mean	0.448	1,239	47.9	\$70,186
	Median	0.481	1,045	49.0	\$53,220
Dark Brown	Mean	0.359	1,095	48.4	\$79,240
	Median	0.377	900	49.0	\$56,248
Black	Mean	0.254	721	49.4	\$65,792
	Median	0.241	560	49.0	\$44,000
Gray	Mean	0.264	630	48.1	\$44,570
	Median	0.250	515	49.0	\$30,325
<u>Total Prairies</u>	Mean	0.354	813	48.3	\$53,993
	Median	0.373	645	49.0	\$40,000

Source: 1981 Census of Agriculture.

Table A.8 Mean and Median Values Based on Individual Grain Farm Data, Selected Variables, by Province and Zone, 1981 Census of Agriculture (Continued)

Province & Zone		Operators Days of OFF Farm Work	Ag Chemical Expense/ Cropland Acre	Fertilizer Expense/ Cropland Acre	Machinery Value/ Cultivated Acre
<u>Manitoba</u>					
Black	Mean	32	\$5.30	\$12.86	\$135
	Median	0	\$3.89	\$10.60	\$120
Gray	Mean	47	\$4.41	\$ 9.73	\$142
	Median	0	\$2.86	\$ 7.49	\$122
<u>Saskatchewan</u>					
Brown	Mean	30	\$2.26	\$ 2.30	\$ 97
	Median	0	\$1.18	\$ 0	\$ 84
Dark Brown	Mean	36	\$3.02	\$ 4.19	\$105
	Median	0	\$1.68	\$ 1.64	\$ 92
Black	Mean	38	\$3.92	\$ 6.97	\$121
	Median	0	\$2.55	\$ 5.00	\$107
Gray	Mean	38	\$4.43	\$ 9.34	\$126
	Median	0	\$3.07	\$ 7.49	\$111
<u>Alberta</u>					
Brown	Mean	29	\$2.02	\$ 1.95	\$101
	Median	0	\$1.30	\$ 0	\$ 92
Dark Brown	Mean	27	\$3.89	\$ 7.65	\$121
	Median	0	\$2.86	\$ 6.22	\$108
Black	Mean	42	\$4.78	\$11.75	\$167
	Median	0	\$3.66	\$10.00	\$146
Gray	Mean	58	\$3.41	\$11.20	\$175
	Median	0	\$2.02	\$ 9.09	\$149
<u>Total Prairies</u>					
	Mean	37	\$3.63	\$ 6.97	\$123
	Median	0	\$2.19	\$ 4.62	\$105

Source: 1981 Census of Agriculture.



Appendix B

SF Intensities of Saskatchewan Grain Farms  
by Soil-Climatic Zone

Legend

- Count - Number of farms in table cell
- SF Area - SF Acreage in cell
- CU Area - Cultivated Acreage in cell
- SF Intensity - SF Area divided by CU Area in cell

Table B.1 SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO CATEGORIES OF CULTIVATED LAND, BY SOIL-CLIMATIC ZONE, 1981 CENSUS OF AGRICULTURE  
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	BROWN ZONE	DARK BROWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TOTAL
<b>UNDER 450 ACRES</b>					
COUNT.....	1,331	2,464	4,538	1,614	9,947
SF AREA.....	190,699	322,046	521,692	163,416	1,197,853
CU AREA.....	412,387	752,495	1,419,945	501,644	3,086,471
SF INTENSITY....	0.462	0.428	0.367	0.326	0.388
<b>450-749 ACRES</b>					
COUNT.....	2,309	3,773	4,884	1,560	12,526
SF AREA.....	641,428	956,228	986,076	266,552	2,850,284
CU AREA.....	1,376,668	2,236,532	2,849,581	905,206	7,367,987
SF INTENSITY....	0.466	0.428	0.346	0.294	0.387
<b>750-1199 ACRES</b>					
COUNT.....	2,777	4,177	3,302	937	11,193
SF AREA.....	1,221,685	1,682,017	1,012,979	239,098	4,155,779
CU AREA.....	2,629,841	3,914,796	3,052,009	868,173	10,464,819
SF INTENSITY....	0.465	0.430	0.332	0.275	0.397
<b>1200-2199 ACRES</b>					
COUNT.....	2,046	2,552	1,442	374	6,414
SF AREA.....	1,463,516	1,640,792	661,324	138,040	3,903,672
CU AREA.....	3,141,013	3,867,006	2,189,100	567,998	9,765,117
SF INTENSITY....	0.466	0.424	0.302	0.243	0.400
<b>2200 ACRES &amp; OVER</b>					
COUNT.....	461	522	293	76	1,352
SF AREA.....	615,670	647,633	254,570	46,833	1,564,706
CU AREA.....	1,347,716	1,584,235	895,400	217,500	4,044,851
SF INTENSITY....	0.457	0.409	0.284	0.215	0.387
<b>TOTAL</b>					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY....	0.464	0.425	0.330	0.279	0.394

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Table B.2 SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO CATEGORIES OF FARM ORGANIZATION, BY SOIL-CLIMATIC ZONE, 1981 CENSUS OF AGRICULTURE  
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	BROWN ZONE	DARK BROWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TOTAL
INDIVIDUAL					
COUNT.....	7,946	12,012	12,873	4,052	36,883
SF AREA.....	3,441,105	4,400,945	2,873,607	718,505	11,434,162
CU AREA.....	7,378,207	10,270,774	8,503,424	2,491,927	28,644,332
SF INTENSITY..	0.466	0.429	0.338	0.288	0.399
PARTNER-WRITTEN					
COUNT.....	175	253	263	71	762
SF AREA.....	90,523	110,076	88,241	16,248	305,088
CU AREA.....	198,580	270,137	294,806	67,656	831,179
SF INTENSITY..	0.456	0.407	0.299	0.240	0.367
PARTNER-VERBAL					
COUNT.....	438	743	940	345	2,466
SF AREA.....	269,781	361,258	301,792	86,845	1,019,676
CU AREA.....	586,552	862,191	972,219	349,542	2,770,504
SF INTENSITY..	0.460	0.419	0.310	0.248	0.368
FAMILY CORP.					
COUNT.....	342	447	341	83	1,213
SF AREA.....	312,151	350,966	151,860	27,329	842,306
CU AREA.....	699,970	875,467	568,400	132,180	2,276,017
SF INTENSITY..	0.446	0.401	0.267	0.207	0.370
OTHER CORP.					
COUNT.....	15	17	22	6	60
SF AREA.....	14,633	16,585	8,190	2,180	41,588
CU AREA.....	32,662	41,792	32,823	10,361	117,638
SF INTENSITY..	0.448	0.397	0.250	0.210	0.354
OTHERS					
COUNT.....	8	16	20	4	48
SF AREA.....	4,805	8,886	12,951	2,832	29,474
CU AREA.....	11,654	34,703	34,363	8,855	89,575
SF INTENSITY..	0.412	0.256	0.377	0.320	0.329
TOTAL					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY..	0.464	0.425	0.330	0.279	0.394

Table B.3 SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO CATEGORIES OF FARM TENURE, BY SOIL-CLIMATIC ZONE, 1981 CENSUS OF AGRICULTURE  
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	BROWN ZONE	DARK BROWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TOTAL
OWNER					
COUNT.....	4,102	6,061	7,048	1,820	19,031
SF AREA.....	1,552,860	1,901,898	1,406,274	276,674	5,137,706
CU AREA.....	3,334,530	4,437,896	3,974,136	914,863	12,661,425
SF INTENSITY..	0.466	0.429	0.354	0.302	0.406
TENANT					
COUNT.....	770	1,179	794	232	2,975
SF AREA.....	266,879	356,217	165,668	37,904	826,668
CU AREA.....	565,710	816,413	474,778	130,124	1,987,025
SF INTENSITY..	0.472	0.436	0.349	0.291	0.416
PT.OWN-PT.RENT					
COUNT.....	4,052	6,248	6,617	2,509	19,426
SF AREA.....	2,313,259	2,990,601	1,864,699	539,361	7,707,920
CU AREA.....	5,007,385	7,100,755	5,957,121	2,015,534	20,080,795
SF INTENSITY..	0.462	0.421	0.313	0.268	0.384
TOTAL					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY..	0.464	0.425	0.330	0.279	0.394

Table B.4

SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO  
CATEGORIES OF OPERATOR AGE, BY SOIL-CLIMATIC ZONE, 1981 CENSUS OF  
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	BROWN ZONE	DARK BROWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TOTAL
<b>UNDER 30 YRS</b>					
COUNT.....	1,694	2,134	1,980	575	6,383
SF AREA.....	695,403	761,433	429,385	106,403	1,992,624
CU AREA.....	1,497,193	1,803,310	1,383,225	409,630	5,093,358
SF INTENSITY..	0.464	0.422	0.310	0.260	0.391
<b>30-39 YRS</b>					
COUNT.....	1,670	2,572	3,037	946	8,225
SF AREA.....	909,748	1,117,739	741,812	187,848	2,957,147
CU AREA.....	1,972,429	2,694,876	2,427,566	721,782	7,816,653
SF INTENSITY..	0.461	0.415	0.306	0.260	0.378
<b>40-49 YRS</b>					
COUNT.....	1,608	2,578	3,070	1,074	8,330
SF AREA.....	883,097	1,161,249	853,527	222,724	3,120,597
CU AREA.....	1,911,814	2,773,982	2,571,128	798,625	8,055,549
SF INTENSITY..	0.462	0.419	0.332	0.279	0.387
<b>50-59 YRS</b>					
COUNT.....	2,223	3,365	3,666	1,188	10,442
SF AREA.....	1,041,195	1,346,617	888,500	222,062	3,498,374
CU AREA.....	2,239,420	3,121,842	2,614,286	774,342	8,749,890
SF INTENSITY..	0.465	0.431	0.340	0.287	0.400
<b>60 YRS &amp; OVER</b>					
COUNT.....	1,729	2,839	2,706	778	8,052
SF AREA.....	603,555	861,678	523,417	114,902	2,103,552
CU AREA.....	1,286,769	1,961,054	1,409,830	356,142	5,013,795
SF INTENSITY..	0.469	0.439	0.371	0.323	0.420
<b>TOTAL</b>					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY..	0.464	0.425	0.330	0.279	0.394

Table B.5 SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO CATEGORIES OF DAYS OF OFF-FARM WORK, BY SOIL-CLIMATIC ZONE, 1981 CENSUS OF AGRICULTURE  
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	BROWN ZONE	DARK BRDWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TDAL
-----					
NO OFF-FARM WORK					
COUNT.....	6,748	9,848	10,291	3,135	30,022
SF AREA.....	3,288,441	4,069,734	2,605,671	613,401	10,577,247
CU AREA.....	7,068,780	9,543,961	7,821,265	2,199,387	26,633,393
SF INTENSITY...	0.465	0.426	0.333	0.279	0.397
1-49 DAYS					
COUNT.....	692	963	1,139	357	3,151
SF AREA.....	309,404	371,055	255,741	66,879	1,003,079
CU AREA.....	680,506	889,394	815,819	247,978	2,633,697
SF INTENSITY...	0.455	0.417	0.313	0.270	0.381
50-99 DAYS					
COUNT.....	389	656	750	344	2,139
SF AREA.....	163,163	230,928	159,455	62,075	615,621
CU AREA.....	360,977	549,614	510,751	225,506	1,646,848
SF INTENSITY...	0.452	0.420	0.312	0.275	0.374
100-199 DAYS					
COUNT.....	468	781	934	344	2,527
SF AREA.....	178,431	257,241	185,453	56,459	677,584
CU AREA.....	384,544	610,111	573,625	198,496	1,766,776
SF INTENSITY...	0.464	0.422	0.323	0.284	0.384
200 DAYS & OVER					
COUNT.....	627	1,240	1,345	381	3,593
SF AREA.....	193,559	319,758	230,321	55,125	798,763
CU AREA.....	412,818	761,984	684,575	189,154	2,048,531
SF INTENSITY...	0.469	0.420	0.336	0.291	0.390
TOTAL					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY...	0.464	0.425	0.330	0.279	0.394
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Table B.5

SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO  
CATEGORIES OF FERTILIZER EXPENSE PER ACRE OF CROPLAND, BY  
SOIL-CLIMATIC ZONE, 1981 CENSUS OF AGRICULTURE  
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	BROWN ZONE	DARK BROWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TOTAL
NO EXPENSE					
COUNT.....	5,190	6,031	4,021	666	15,908
SF AREA.....	2,208,761	2,168,054	930,199	116,531	5,423,545
CU AREA.....	4,653,245	4,795,210	2,358,574	353,440	12,160,469
SF INTENSITY..	0.475	0.452	0.394	0.330	0.446
\$0.01-\$4.99					
COUNT.....	2,099	3,148	3,180	920	9,347
SF AREA.....	1,072,942	1,333,640	765,322	161,883	3,333,787
CU AREA.....	2,354,667	3,149,082	2,254,335	538,904	8,296,988
SF INTENSITY..	0.456	0.424	0.339	0.300	0.402
\$5.00-\$9.99					
COUNT.....	1,202	2,597	3,616	1,313	8,728
SF AREA.....	633,365	1,057,339	885,874	260,556	2,837,134
CU AREA.....	1,399,961	2,562,202	2,701,890	874,091	7,538,144
SF INTENSITY..	0.452	0.413	0.328	0.298	0.376
\$10.00-\$14.99					
COUNT.....	286	995	1,901	769	3,951
SF AREA.....	149,538	414,178	465,885	151,691	1,181,292
CU AREA.....	346,715	1,088,840	1,607,563	594,797	3,637,915
SF INTENSITY..	0.431	0.380	0.290	0.255	0.325
\$15.00 & OVER					
COUNT.....	147	717	1,741	893	3,498
SF AREA.....	68,392	275,505	389,361	163,278	896,536
CU AREA.....	153,037	759,730	1,483,673	699,289	3,095,729
SF INTENSITY..	0.447	0.363	0.262	0.234	0.290
TOTAL					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY..	0.464	0.425	0.330	0.279	0.394

Table B.7

SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO  
CATEGORIES OF CHEMICAL EXPENSE PER ACRE OF CROPLAND, BY  
SOIL-CLIMATIC ZONE, 1981 CENSUS OF AGRICULTURE  
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	BROWN ZONE	DARK BROWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TOTAL
NO EXPENSE					
COUNT.....	2,386	3,580	3,596	731	10,293
SF AREA.....	911,290	1,207,089	790,428	126,775	3,035,582
CU AREA.....	1,938,391	2,774,144	2,132,227	408,664	7,253,426
SF INTENSITY..	0.470	0.435	0.371	0.310	0.419
\$0.01-\$1.99					
COUNT.....	3,343	3,638	2,943	1,015	10,939
SF AREA.....	1,597,961	1,491,315	690,869	189,790	3,969,935
CU AREA.....	3,455,735	3,477,727	2,065,590	665,075	9,664,127
SF INTENSITY..	0.462	0.429	0.334	0.285	0.411
\$2.00-\$4.99					
COUNT.....	2,030	3,276	3,539	1,264	10,109
SF AREA.....	1,052,927	1,323,617	875,540	239,079	3,491,163
CU AREA.....	2,276,156	3,182,444	2,755,653	857,508	9,071,761
SF INTENSITY..	0.463	0.416	0.318	0.279	0.385
\$5.00-\$7.99					
COUNT.....	722	1,759	2,402	819	5,702
SF AREA.....	360,404	751,321	600,203	160,234	1,872,162
CU AREA.....	784,495	1,796,692	1,927,992	592,426	5,101,605
SF INTENSITY..	0.459	0.418	0.311	0.270	0.367
\$8.00 & OVER					
COUNT.....	443	1,235	1,979	732	4,389
SF AREA.....	210,416	475,374	479,601	138,061	1,303,452
CU AREA.....	452,848	1,124,057	1,524,573	536,848	3,638,326
SF INTENSITY..	0.465	0.423	0.315	0.257	0.358
TOTAL					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY..	0.464	0.425	0.330	0.279	0.394

Table B.8

SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO  
CATEGORIES OF VALUE OF MACHINERY PER ACRE OF CULTIVATED LAND, BY  
SOIL-CLIMATIC ZONE, 1981 CENSUS OF AGRICULTURE  
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	BROWN ZONE	DARK BROWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TOTAL
-----					
UNDER \$50.00					
COUNT.....	1,939	2,342	1,919	521	6,721
SF AREA.....	757,072	788,670	403,900	96,157	2,045,799
CU AREA.....	1,605,319	1,801,419	1,104,169	301,450	4,812,357
SF INTENSITY..	0.472	0.438	0.366	0.319	0.425
\$50.00-\$99.99					
COUNT.....	3,664	5,234	4,609	1,423	14,930
SF AREA.....	1,897,343	2,256,620	1,176,510	284,188	5,614,661
CU AREA.....	4,079,752	5,237,119	3,429,619	944,206	13,690,696
SF INTENSITY..	0.465	0.431	0.343	0.301	0.410
\$100.00-\$149.99					
COUNT.....	2,134	3,608	4,124	1,326	11,192
SF AREA.....	1,044,754	1,506,426	1,075,773	262,663	3,889,616
CU AREA.....	2,272,371	3,609,908	3,314,396	984,116	10,180,791
SF INTENSITY..	0.460	0.417	0.325	0.267	0.382
\$150.00-\$199.99					
COUNT.....	718	1,404	2,173	681	4,976
SF AREA.....	296,669	478,170	492,075	122,283	1,389,197
CU AREA.....	649,553	1,154,156	1,600,247	491,166	3,895,122
SF INTENSITY..	0.457	0.414	0.308	0.249	0.357
\$200.00 & OVER					
COUNT.....	469	900	1,634	610	3,613
SF AREA.....	137,160	218,830	288,383	88,648	733,021
CU AREA.....	300,630	552,462	957,604	339,583	2,150,279
SF INTENSITY..	0.456	0.396	0.301	0.261	0.341
TOTAL					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY..	0.464	0.425	0.330	0.279	0.394
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Table B:9

SUMMERFALLOW INTENSITIES ON SASKATCHEWAN GRAIN FARMS, ACCORDING TO  
CATEGORIES OF AGRICULTURAL SALES, BY SOIL-CLIMATIC ZONE, 1981 CENSUS  
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	BROWN ZONE	DARK BROWN ZONE	BLACK ZONE	GREY ZONE	SASKATCHEWAN TDIAL
<b>\$10000-\$24999</b>					
COUNT.....	1,776	3,196	4,562	1,493	11,027
SF AREA.....	400,839	642,655	675,211	190,234	1,908,939
CU AREA.....	849,241	1,457,720	1,781,491	554,427	4,642,879
SF INTENSITY.	0.472	0.441	0.379	0.343	0.411
<b>\$25000-\$39999</b>					
COUNT.....	1,922	3,031	3,530	1,039	9,522
SF AREA.....	617,728	881,501	735,394	172,348	2,406,971
CU AREA.....	1,310,486	2,020,152	2,016,509	555,845	5,902,992
SF INTENSITY.	0.471	0.436	0.365	0.310	0.408
<b>\$40000-\$59999</b>					
COUNT.....	2,098	3,095	2,716	910	8,819
SF AREA.....	909,605	1,200,797	684,911	184,313	2,979,626
CU AREA.....	1,943,328	2,763,883	2,015,829	651,290	7,374,330
SF INTENSITY.	0.468	0.434	0.340	0.283	0.404
<b>\$60000-\$79999</b>					
COUNT.....	1,395	1,902	1,552	482	5,331
SF AREA.....	768,189	912,021	463,111	112,963	2,256,284
CU AREA.....	1,645,085	2,125,194	1,472,974	416,938	5,660,191
SF INTENSITY.	0.467	0.429	0.314	0.271	0.399
<b>\$80000 &amp; OVER</b>					
COUNT.....	1,733	2,264	2,099	637	6,733
SF AREA.....	1,436,637	1,611,742	878,014	194,081	4,120,474
CU AREA.....	3,159,485	3,988,115	3,119,232	882,021	11,148,853
SF INTENSITY.	0.455	0.404	0.281	0.220	0.370
<b>TOTAL</b>					
COUNT.....	8,924	13,488	14,459	4,561	41,432
SF AREA.....	4,132,998	5,248,716	3,436,641	853,939	13,672,294
CU AREA.....	8,907,625	12,355,064	10,406,035	3,060,521	34,729,245
SF INTENSITY.	0.464	0.425	0.330	0.279	0.394

Appendix C

SF Intensities of Grain Farms in the  
Black Zone

Legend

Count - Number of farms in table cell  
SF Area - SF Acreage in cell  
CU Area - Cultivated Acreage in cell  
SF Intensity - SF Area divided by CU Area in cell

Table C.1

SUMMERFALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
ACCORDING TO CATEGORIES OF CULTIVATED LAND, BY PROVINCE,  
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	REQUEST NUMBER 1		PAGE 1	
	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
<hr/>				
UNDER 450 ACRES				
COUNT.....	2,287	4,538	1,846	8,671
SF AREA.....	173,990	521,692	144,854	840,536
CU AREA.....	695,364	1,419,945	538,889	2,654,198
SF INTENSITY....	0.250	0.367	0.269	0.317
450-749 ACRES				
COUNT.....	1,902	4,884	1,406	8,192
SF AREA.....	230,912	986,076	209,480	1,426,468
CU AREA.....	1,095,175	2,849,581	826,901	4,771,657
SF INTENSITY....	0.211	0.346	0.253	0.299
750-1199 ACRES				
COUNT.....	1,104	3,302	947	5,353
SF AREA.....	195,319	1,012,979	208,675	1,416,973
CU AREA.....	1,020,358	3,052,009	885,120	4,957,487
SF INTENSITY....	0.191	0.332	0.236	0.286
1200-2199 ACRES				
COUNT.....	468	1,442	518	2,428
SF AREA.....	112,143	661,324	184,579	958,046
CU AREA.....	709,038	2,189,100	804,447	3,702,585
SF INTENSITY....	0.158	0.302	0.229	0.259
2200 ACRES & OVER				
COUNT.....	107	293	129	529
SF AREA.....	39,982	254,570	94,356	388,908
CU AREA.....	326,025	895,400	439,427	1,660,852
SF INTENSITY....	0.123	0.284	0.215	0.234
TOTAL				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY....	0.196	0.330	0.241	0.283



Table C.2

SUMMER FALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
ACCORDING TO CATEGORIES OF FARM ORGANIZATION, BY PROVINCE,  
1981 CENSUS OF AGRICULTURE  
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	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
<b>INDIVIDUAL</b>				
COUNT.....	5,111	12,873	4,180	22,164
SF AREA.....	621,743	2,873,607	670,760	4,166,110
CU AREA.....	2,985,422	8,503,424	2,679,022	14,167,868
SF INTENSITY..	0.208	0.338	0.250	0.294
<b>PARTNER-WRITTEN</b>				
COUNT.....	119	263	110	492
SF AREA.....	18,263	88,241	27,859	134,363
CU AREA.....	117,690	294,806	125,641	538,137
SF INTENSITY..	0.155	0.299	0.222	0.250
<b>PARTNER-VERBAL</b>				
COUNT.....	437	940	359	1,736
SF AREA.....	71,085	301,792	70,127	443,004
CU AREA.....	413,868	972,219	317,013	1,703,100
SF INTENSITY..	0.172	0.310	0.221	0.260
<b>FAMILY CORP.</b>				
COUNT.....	189	341	178	708
SF AREA.....	38,142	151,860	64,719	254,721
CU AREA.....	304,154	568,400	315,165	1,187,719
SF INTENSITY..	0.125	0.267	0.205	0.214
<b>OTHER CORP.</b>				
COUNT.....	11	22	13	46
SF AREA.....	3,071	8,190	4,729	15,990
CU AREA.....	23,764	32,823	40,396	96,983
SF INTENSITY..	0.129	0.250	0.117	0.165
<b>OTHERS</b>				
COUNT.....	1	20	6	27
SF AREA.....	42	12,951	3,750	16,743
CU AREA.....	1,062	34,363	17,547	52,972
SF INTENSITY..	0.040	0.377	0.214	0.316
<b>TOTAL</b>				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY..	0.196	0.330	0.241	0.283

Table C.3

SUMMERFALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
 ACCORDING TO CATEGORIES OF FARM TENURE, BY PROVINCE,  
 1981 CENSUS OF AGRICULTURE  
 SELECTION CRITERIA  
 AGG GE 1

	REQUEST NUMBER 2		PAGE 1	
	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
OWNER				
COUNT.....	2,704	7,048	2,001	11,753
SF AREA.....	307,424	1,406,274	274,162	1,987,860
CU AREA.....	1,331,809	3,974,136	1,003,365	6,309,310
SF INTENSITY.	0.231	0.354	0.273	0.315
TENANT				
COUNT.....	370	794	313	1,477
SF AREA.....	38,228	165,668	54,004	257,900
CU AREA.....	198,828	474,778	227,286	900,892
SF INTENSITY.	0.192	0.349	0.238	0.286
PT.OWN-PT.RENT				
COUNT.....	2,794	6,617	2,532	11,943
SF AREA.....	406,694	1,864,699	513,778	2,785,171
CU AREA.....	2,315,323	5,957,121	2,264,133	10,536,577
SF INTENSITY.	0.176	0.313	0.227	0.264
TOTAL				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY.	0.196	0.330	0.241	0.283

Table C.4 SUMMERFALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
 ACCORDING TO CATEGORIES OF OPERATOR AGE, BY PROVINCE,  
 1981 CENSUS OF AGRICULTURE  
 SELECTION CRITERIA  
 AGG GE 1

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	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
-----				
UNDER 30 YRS				
COUNT.....	828	1,980	568	3,376
SF AREA.....	93,262	429,385	88,104	610,751
CU AREA.....	544,769	1,383,225	415,066	2,343,060
SF INTENSITY.	0.171	0.310	0.212	0.261
30-39 YRS				
COUNT.....	1,246	3,037	914	5,197
SF AREA.....	171,895	741,812	167,192	1,080,899
CU AREA.....	955,411	2,427,566	758,063	4,141,040
SF INTENSITY.	0.180	0.306	0.221	0.261
40-49 YRS				
COUNT.....	1,117	3,070	1,076	5,263
SF AREA.....	160,367	853,527	205,278	1,219,172
CU AREA.....	853,744	2,571,128	883,750	4,308,622
SF INTENSITY.	0.188	0.332	0.232	0.283
50-59 YRS				
COUNT.....	1,569	3,666	1,293	6,528
SF AREA.....	205,190	888,500	233,403	1,327,093
CU AREA.....	986,936	2,614,286	903,366	4,504,588
SF INTENSITY.	0.208	0.340	0.258	0.295
60 YRS & OVER				
COUNT.....	1,108	2,706	995	4,809
SF AREA.....	121,632	523,417	147,967	793,016
CU AREA.....	505,100	1,409,830	534,539	2,449,469
SF INTENSITY.	0.241	0.371	0.277	0.324
TOTAL				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY.	0.196	0.330	0.241	0.283
-----				

Table C.5

SUMMERFALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
 ACCORDING TO CATEGORIES OF DAYS OF OFF-FARM WORK, BY PROVINCE,  
 1981 CENSUS OF AGRICULTURE  
 SELECTION CRITERIA  
 AG6 GE 1

	REQUEST NUMBER 5		PAGE 1	
	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
NO OFF-FARM WORK				
COUNT.....	4,267	10,291	3,371	17,929
SF AREA.....	580,732	2,605,671	636,852	3,823,255
CU AREA.....	2,969,238	7,821,265	2,668,079	13,458,582
SF INTENSITY...	0.196	0.333	0.239	0.284
1-49 DAYS				
COUNT.....	511	1,139	385	2,035
SF AREA.....	57,635	255,741	68,512	381,888
CU AREA.....	331,187	815,819	269,648	1,416,654
SF INTENSITY...	0.174	0.313	0.254	0.270
50-99 DAYS				
COUNT.....	300	750	220	1,270
SF AREA.....	31,901	159,455	32,246	223,602
CU AREA.....	165,973	510,751	143,661	820,385
SF INTENSITY...	0.192	0.312	0.224	0.273
100-199 DAYS				
COUNT.....	333	934	353	1,620
SF AREA.....	36,426	185,453	47,994	269,873
CU AREA.....	192,476	573,625	190,142	946,243
SF INTENSITY...	0.200	0.323	0.252	0.285
200 DAYS & OVER				
COUNT.....	457	1,345	517	2,319
SF AREA.....	45,652	230,321	56,340	332,313
CU AREA.....	197,086	684,575	223,254	1,104,915
SF INTENSITY...	0.232	0.336	0.252	0.301
TOTAL				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY...	0.196	0.330	0.241	0.283

Table C.6 SUMMERFALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
 ACCORDING TO CATEGORIES OF FERTILIZER EXPENSE PER ACRE OF CROPLAND,  
 BY PROVINCE, 1981 CENSUS OF AGRICULTURE  
 SELECTION CRITERIA  
 AG6 GE 1

	REQUEST NUMBER 6		PAGE 1	
	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
-----				
NO EXPENSE				
COUNT.....	719	4,021	485	5,225
SF AREA.....	96,246	930,199	72,906	1,099,351
CU AREA.....	335,139	2,358,574	244,197	2,937,910
SF INTENSITY.	0.287	0.394	0.299	0.374
\$0.01-\$4.99				
COUNT.....	759	3,180	605	4,544
SF AREA.....	108,118	765,322	122,187	995,627
CU AREA.....	442,057	2,254,335	429,764	3,126,156
SF INTENSITY.	0.245	0.339	0.284	0.318
\$5.00-\$9.99				
COUNT.....	1,285	3,616	1,290	6,191
SF AREA.....	168,569	885,874	245,142	1,299,585
CU AREA.....	768,642	2,701,890	885,228	4,355,760
SF INTENSITY.	0.219	0.328	0.277	0.298
\$10.00-\$14.99				
COUNT.....	1,208	1,901	1,090	4,199
SF AREA.....	153,111	465,885	186,256	805,252
CU AREA.....	838,408	1,607,563	824,334	3,270,305
SF INTENSITY.	0.183	0.290	0.226	0.246
\$15.00 & OVER				
COUNT.....	1,897	1,741	1,376	5,014
SF AREA.....	226,302	389,361	215,453	831,116
CU AREA.....	1,461,714	1,483,673	1,111,261	4,056,648
SF INTENSITY.	0.155	0.262	0.194	0.205
TOTAL				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY.	0.196	0.330	0.241	0.293
-----				

Table C.7 SUMMERFALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
 ACCORDING TO CATEGORIES OF CHEMICAL EXPENSE PER ACRE OF  
 CROPLAND, BY PROVINCE, 1981 CENSUS OF AGRICULTURE  
 SELECTION CRITERIA

AG6 GE 1

REQUEST NUMBER 8

PAGE 1

	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
NO EXPENSE				
COUNT.....	885	3,596	580	5,061
SF AREA.....	113,465	790,428	88,855	992,748
CU AREA.....	459,827	2,132,227	327,634	2,919,688
SF INTENSITY..	0.247	0.371	0.271	0.340
\$0.01-\$1.99				
COUNT.....	1,055	2,943	917	4,915
SF AREA.....	132,989	690,869	162,807	986,665
CU AREA.....	603,750	2,065,590	649,020	3,318,360
SF INTENSITY..	0.220	0.334	0.251	0.297
\$2.00-\$4.99				
COUNT.....	1,465	3,539	1,475	6,479
SF AREA.....	188,485	875,540	264,157	1,328,182
CU AREA.....	999,165	2,755,653	1,100,599	4,855,417
SF INTENSITY..	0.189	0.318	0.240	0.274
\$5.00-\$7.99				
COUNT.....	1,093	2,402	994	4,489
SF AREA.....	138,406	600,203	176,302	914,911
CU AREA.....	777,214	1,927,992	737,575	3,442,781
SF INTENSITY..	0.178	0.311	0.239	0.266
\$8.00 & OVER				
COUNT.....	1,370	1,979	880	4,229
SF AREA.....	179,001	479,601	149,823	808,425
CU AREA.....	1,006,004	1,524,573	679,956	3,210,533
SF INTENSITY..	0.178	0.315	0.220	0.252
TOTAL				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY..	0.196	0.330	0.241	0.283



Table C.8

SUMMERFALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
 ACCORDING TO CATEGORIES OF VALUE OF MACHINERY PER ACRE OF  
 CULTIVATED LAND, BY PROVINCE, 1981 CENSUS OF AGRICULTURE  
 SELECTION CRITERIA  
 AG6 GE 1

	REQUEST NUMBER 9		PAGE 1	
	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
-----				
UNDER \$50.00				
COUNT.....	587	1,919	328	2,834
SF AREA.....	75,550	403,900	54,621	534,071
CU AREA.....	315,042	1,104,169	178,906	1,598,117
SF INTENSITY..	0.240	0.366	0.305	0.334
\$50.00-\$99.99				
COUNT.....	1,582	4,609	903	7,094
SF AREA.....	224,460	1,176,510	182,279	1,583,249
CU AREA.....	1,071,575	3,429,619	677,136	5,178,330
SF INTENSITY..	0.209	0.343	0.269	0.306
\$100.00-\$149.99				
COUNT.....	1,752	4,124	1,278	7,154
SF AREA.....	242,488	1,075,773	264,873	1,583,134
CU AREA.....	1,250,224	3,314,396	1,083,319	5,647,939
SF INTENSITY..	0.194	0.325	0.245	0.280
\$150.00-\$199.99				
COUNT.....	1,011	2,173	989	4,173
SF AREA.....	117,846	492,075	173,629	783,550
CU AREA.....	693,702	1,600,247	775,701	3,069,650
SF INTENSITY..	0.170	0.308	0.224	0.255
\$200.00 & OVER				
COUNT.....	936	1,634	1,348	3,918
SF AREA.....	92,002	288,383	166,542	546,927
CU AREA.....	515,417	957,604	779,722	2,252,743
SF INTENSITY..	0.179	0.301	0.214	0.243
TOTAL				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY..	0.196	0.330	0.241	0.283
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Table C.9

SUMMERFALLOW INTENSITIES ON GRAIN FARMS IN THE BLACK ZONE,  
 ACCORDING TO CATEGORIES OF AGRICULTURAL SALES, BY PROVINCE,  
 1981 CENSUS OF AGRICULTURE  
 SELECTION CRITERIA  
 AG6 GE 1

	MANITOBA BLACK	SASKATCHEWAN BLACK	ALBERTA BLACK	TOTAL PRAIRIE BLACK ZONE
REQUEST NUMBER 10 PAGE 1				
\$10000-\$24999				
COUNT.....	1,643	4,562	1,299	7,504
SF AREA.....	149,203	675,211	123,308	947,722
CU AREA.....	552,034	1,781,491	419,239	2,752,764
SF INTENSITY.	0.270	0.379	0.294	0.344
\$25000-\$39999				
COUNT.....	1,356	3,530	875	5,761
SF AREA.....	154,521	735,394	115,661	1,005,576
CU AREA.....	637,610	2,016,509	416,366	3,070,485
SF INTENSITY.	0.242	0.365	0.278	0.328
\$40000-\$59999				
COUNT.....	1,113	2,716	931	4,760
SF AREA.....	151,507	684,911	158,375	994,793
CU AREA.....	712,551	2,015,829	594,219	3,322,599
SF INTENSITY.	0.213	0.340	0.267	0.299
\$60000-\$79999				
COUNT.....	724	1,552	589	2,865
SF AREA.....	109,338	463,111	115,350	687,799
CU AREA.....	590,939	1,472,974	462,805	2,526,718
SF INTENSITY.	0.185	0.314	0.249	0.272
\$80000 & OVER				
COUNT.....	1,032	2,099	1,152	4,283
SF AREA.....	187,777	878,014	329,250	1,395,041
CU AREA.....	1,352,826	3,119,232	1,602,155	6,074,213
SF INTENSITY.	0.139	0.281	0.206	0.230
TOTAL				
COUNT.....	5,868	14,459	4,846	25,173
SF AREA.....	752,346	3,436,641	841,944	5,030,931
CU AREA.....	3,845,960	10,406,035	3,494,784	17,746,779
SF INTENSITY.	0.196	0.330	0.241	0.283

Appendix D

Selected Correlation Matrices  
for Grain Farms

Legend

Ratio - SF Intensity  
Cultiv - Cultivated Area per farm  
Agrage - Age of Operator  
Wrkoff - Days of off-farm work  
Fertex - Fertilizer Expense per unit of cropland  
Chemac - Ag Chemical Expense per unit of cropland  
Mchval - Machinery Value per unit of cultivated land  
Tsales - Total Ag sales

Matrix D.1 Correlation Coefficients of Grain Farms in the Manitoba Black Zone, 1981

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 5868

	RATIO	CULTIV	AGRAGE	WRKOFF	FERTEX	CHEMAC	MCHVAL	TSALES
RATIO	1.00000 0.0000	-0.23170 0.0001	0.16591 0.0001	0.03878 0.0030	-0.18912 0.0001	-0.03739 0.0042	-0.09048 0.0001	-0.29344 0.0001
CULTIV	-0.23170 0.0001	1.00000 0.0000	-0.16698 0.0001	-0.14888 0.0001	0.14365 0.0001	0.09276 0.0001	-0.05950 0.0001	0.77122 0.0001
AGRAGE	0.16591 0.0001	-0.16698 0.0001	1.00000 0.0000	-0.21312 0.0001	-0.08365 0.0001	-0.08356 0.0001	0.14040 0.0001	-0.10328 0.0001
WRKOFF	0.03878 0.0030	-0.14888 0.0001	-0.21312 0.0001	1.00000 0.0000	-0.00022 0.9866	-0.00584 0.6546	-0.02498 0.0556	-0.16048 0.0001
FERTEX	-0.18912 0.0001	0.14365 0.0001	-0.08365 0.0001	-0.00022 0.9866	1.00000 0.0000	0.41967 0.0001	0.21732 0.0001	0.29925 0.0001
CHEMAC	-0.03739 0.0042	0.09276 0.0001	-0.08356 0.0001	-0.00584 0.6546	0.41967 0.0001	1.00000 0.0000	0.15780 0.0001	0.21424 0.0001
MCHVAL	-0.09048 0.0001	-0.05950 0.0001	0.14040 0.0001	-0.02498 0.0556	0.21732 0.0001	0.15780 0.0001	1.00000 0.0000	0.09816 0.0001
TSALES	-0.29344 0.0001	0.77122 0.0001	-0.10328 0.0001	-0.16048 0.0001	0.29925 0.0001	0.21424 0.0001	0.09816 0.0001	1.00000 0.0000

Matrix D.2 Correlation Coefficients of Grain Farms in the Saskatchewan Brown Zone, 1981

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 8924

	RATIO	CULTIV	AGRAGE	WRKOFF	FERTEX	CHEMAC	MCHVAL	TSALES
RATIO	1.00000 0.0000	-0.01612 0.1278	0.03701 0.0005	0.00682 0.5192	-0.09750 0.0001	0.00749 0.4795	-0.01716 0.1049	-0.08767 0.0001
CULTIV	-0.01612 0.1278	1.00000 0.0000	-0.10157 0.0001	-0.15796 0.0001	0.10220 0.0001	0.03789 0.0003	-0.04601 0.0001	0.73488 0.0001
AGRAGE	0.03701 0.0005	-0.10157 0.0001	1.00000 0.0000	-0.23585 0.0001	-0.03275 0.0020	-0.01111 0.2941	0.06260 0.0001	-0.02981 0.0049
WRKOFF	0.00682 0.5192	-0.15796 0.0001	-0.23585 0.0001	1.00000 0.0000	0.00939 0.3754	0.00457 0.6659	-0.02855 0.0070	-0.16484 0.0001
FERTEX	-0.09750 0.0001	0.10220 0.0001	-0.03275 0.0020	0.00939 0.3754	1.00000 0.0000	0.13110 0.0001	0.05364 0.0001	0.18371 0.0001
CHEMAC	0.00749 0.4795	0.03789 0.0003	-0.01111 0.2941	0.00457 0.6659	0.13110 0.0001	1.00000 0.0000	0.41182 0.0001	0.10297 0.0001
MCHVAL	-0.01716 0.1049	-0.04601 0.0001	0.06260 0.0001	-0.02855 0.0070	0.05364 0.0001	0.41182 0.0001	1.00000 0.0000	0.02877 0.0066
TSALES	-0.08767 0.0001	0.73488 0.0001	-0.02981 0.0049	-0.16484 0.0001	0.18371 0.0001	0.10297 0.0001	0.02877 0.0066	1.00000 0.0000

Matrix D.3 Correlation Coefficients of Grain Farms in the Saskatchewan Dark Brown Zone, 1981

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 13488

	RATIO	CULTIV	AGRAGE	WRKOFF	FERTEX	CHEMAC	MCHVAL	TSALES
RATIO	1.00000 0.0000	-0.03659 0.0001	0.07678 0.0001	-0.02690 0.0018	-0.09538 0.0001	0.00668 0.4378	-0.03548 0.0001	-0.11069 0.0001
CULTIV	-0.03659 0.0001	1.00000 0.0000	-0.11839 0.0001	-0.16382 0.0001	0.06304 0.0001	0.03863 0.0001	-0.06334 0.0001	0.64723 0.0001
AGRAGE	0.07678 0.0001	-0.11839 0.0001	1.00000 0.0000	-0.24314 0.0001	-0.02927 0.0007	-0.02018 0.0191	0.09378 0.0001	-0.04326 0.0001
WRKOFF	-0.02690 0.0018	-0.16382 0.0001	-0.24314 0.0001	1.00000 0.0000	-0.00833 0.3333	0.00970 0.2598	-0.02397 0.0054	-0.13124 0.0001
FERTEX	-0.09538 0.0001	0.06304 0.0001	-0.02927 0.0007	-0.00833 0.3333	1.00000 0.0000	0.18239 0.0001	0.56061 0.0001	0.14348 0.0001
CHEMAC	0.00668 0.4378	0.03863 0.0001	-0.02018 0.0191	0.00970 0.2598	0.18239 0.0001	1.00000 0.0000	0.06998 0.0001	0.11845 0.0001
MCHVAL	-0.03548 0.0001	-0.06334 0.0001	0.09378 0.0001	-0.02397 0.0054	0.56061 0.0001	0.06998 0.0001	1.00000 0.0000	0.03223 0.0002
TSALES	-0.11069 0.0001	0.64723 0.0001	-0.04326 0.0001	-0.13124 0.0001	0.14348 0.0001	0.11845 0.0001	0.03223 0.0002	1.00000 0.0000



Matrix D.4 Correlation Coefficients of Grain Farms in the Saskatchewan Black Zone, 1981

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 14459

	RATIO	CULTIV	AGRAGE	WRKOFF	FERTEX	CHEMAC	MCHVAL	TSALES
RATIO	1.00000 0.0000	-0.15983 0.0001	0.16958 0.0001	-0.00954 0.2512	-0.07390 0.0001	0.01662 0.0457	-0.10439 0.0001	-0.23537 0.0001
CULTIV	-0.15983 0.0001	1.00000 0.0000	-0.13290 0.0001	-0.14174 0.0001	0.05693 0.0001	0.02298 0.0057	-0.04304 0.0001	0.71907 0.0001
AGRAGE	0.16958 0.0001	-0.13290 0.0001	1.00000 0.0000	-0.27622 0.0001	-0.02126 0.0106	-0.00744 0.3709	0.11364 0.0001	-0.07594 0.0001
WRKOFF	-0.00954 0.2512	-0.14174 0.0001	-0.27622 0.0001	1.00000 0.0000	-0.01269 0.1269	-0.00686 0.4095	-0.04395 0.0001	-0.15787 0.0001
FERTEX	-0.07390 0.0001	0.05693 0.0001	-0.02126 0.0106	-0.01269 0.1269	1.00000 0.0000	0.82726 0.0001	0.12206 0.0001	0.14956 0.0001
CHEMAC	0.01662 0.0457	0.02298 0.0057	-0.00744 0.3709	-0.00686 0.4095	0.82726 0.0001	1.00000 0.0000	0.07607 0.0001	0.07580 0.0001
MCHVAL	-0.10439 0.0001	-0.04304 0.0001	0.11364 0.0001	-0.04395 0.0001	0.12206 0.0001	0.07607 0.0001	1.00000 0.0000	0.11506 0.0001
TSALES	-0.23537 0.0001	0.71907 0.0001	-0.07594 0.0001	-0.15787 0.0001	0.14956 0.0001	0.07580 0.0001	0.11506 0.0001	1.00000 0.0000

Matrix D.5 Correlation Coefficients of Grain Farms in the Alberta Black Zone, 1981

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHD=0 / N = 4846

	RATIO	CULTIV	AGRAGE	WRKOFF	FERTEX	CHEMAC	MCHVAL	TSALES
RATIO	1.00000 0.0000	-0.09971 0.0001	0.17332 0.0001	0.02323 0.1059	-0.18750 0.0001	-0.06099 0.0001	-0.14509 0.0001	-0.19712 0.0001
CULTIV	-0.09971 0.0001	1.00000 0.0000	-0.12082 0.0001	-0.17464 0.0001	0.07384 0.0001	0.04058 0.0047	-0.11635 0.0001	0.74296 0.0001
AGRAGE	0.17332 0.0001	-0.12082 0.0001	1.00000 0.0000	-0.24237 0.0001	-0.06560 0.0001	-0.04070 0.0046	0.09339 0.0001	-0.07457 0.0001
WRKOFF	0.02323 0.1059	-0.17464 0.0001	-0.24237 0.0001	1.00000 0.0000	0.00185 0.8974	0.01034 0.4716	0.03318 0.0209	-0.16459 0.0001
FERTEX	-0.18750 0.0001	0.07384 0.0001	-0.06560 0.0001	0.00185 0.8974	1.00000 0.0000	0.23593 0.0001	0.21260 0.0001	0.18873 0.0001
CHEMAC	-0.06099 0.0001	0.04058 0.0047	-0.04070 0.0046	0.01034 0.4716	0.23693 0.0001	1.00000 0.0000	0.10659 0.0001	0.12768 0.0001
MCHVAL	-0.14509 0.0001	-0.11635 0.0001	0.09339 0.0001	0.03318 0.0209	0.21260 0.0001	0.10659 0.0001	1.00000 0.0000	0.02817 0.0499
TSALES	-0.19712 0.0001	0.74296 0.0001	-0.07457 0.0001	-0.16459 0.0001	0.18873 0.0001	0.12768 0.0001	0.02817 0.0499	1.00000 0.0000

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