A COMPARATIVE ASSESSMENT OF ALTERNATIVE AND CONVENTIONAL AGRICULTURAL SYSTEMS IN MANITOBA

by

© BRENDA CHORNEY

A Practicum Submitted
in Partial Fulfillment of the
Requirements for the Degree,
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A Comparitive Assessment of Alternative and Conventional Agricultural Systems in Manitoba.

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Brenda L. Chorney

A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of Master of Natural Resources Management.

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ABSTRACT

Alternative agricultural systems were compared to conventional systems in an economical and environmental context. Alternative agriculture in this study referred to crop production systems which involved low input of synthetic fertilizers and pesticides. Ten farmers using alternative farming techniques were interviewed using a prepared questionnaire to obtain yield, cash costs and other data to assess the environmental and economic implications of alternative agriculture. Data from seven of the 10 farms were used with a 'Crop Production Simulator' to arrive at net cash returns for crop production before labour and investment costs, for 1986 and 1987. Net cash returns per acre for various crops were compared to data simulated from Statistics Canada yield data and Manitoba Agriculture budget data, to represent conventional crop production. Comparisons were made to Agriculture Canada budget data as well.

The results indicate that alternative producers were utilizing soil stabilizing crop rotations as well as leguminous crops and forages. They also indicate that the alternative producers on average had better net cash returns than their average conventional counterparts, at least for wheat for 1986 and 1987. Although oats net cash returns could not be compared, on average oat yields were greater for alternative producers in both years.

Any net cash return advantages that the alternative producers have over conventional crop production is largely due to the alternative farmer's savings in fertilizer and pesticides. There was, however, a great deal of variability between the alternative farmers, both for yields and net cash returns. How much of this variability was due to management practices and how much due to differences in locality and weather variation could not be distinguished. The limitations of two years data preclude any statements being made in reference to the long-term profitability of such agricultural systems. A number of recommendations were made for further studies and to assist producers who have a desire to farm in an alternative manner.

EXECUTIVE SUMMARY

Background

Modern agricultural concerns are prompting some farmers to seek a form of crop production which is less dependent on synthetic fertilizers and pesticides. Such a form of agriculture is often termed 'Alternative Agriculture'. Farmers that adopt such agricultural systems consider this as a means within their control of decreasing the risks and uncertainties of chemical use with regard to environmental protection, economic considerations, and personal health. Although there is a growing data base regarding alternative agriculture, there is still a lack of information pertinent to the prairie provinces of Canada.

Objectives

The objectives of the study were to compare alternative systems to conventional systems in Manitoba in terms of environmental and economic implications. Specifically, the study involved objective comparison of quantitative data with regard to:

- input requirements, including chemicals, fertilizer, fuel, machinery, and labour, and

- overall crop returns including crop yields and grades attained.

As well, it included subjective comparisons of qualitative data with regard to:

- soil and water conservation potential,
- pest problems such as weeds, insects and diseases; the control methods used and the environmental implications of these control methods, and
- the environmental implications of decreased use of agricultural chemicals and fertilizers.

Methods

The methods used in conducting this study consisted of:
(1) A literature search, which included:

- examination of the problems associated with both loss of soil productivity, and use of synthetic fertilizers and pesticides, as well as how implementation of alternative agriculture might affect either of these, and
- review of past economic studies of alternative agriculture.

Some of the subjective comparison of alternative and conventional agriculture, with respect to environmental implications, was accomplished through the literature review.
(2) Informal discussion with members of government, the agricultural industry and the academic community for the purpose of:

- identifying the case study farms described below,
- formulating, modifying and verifying the methods of data collection and analysis, and
- acquiring other information relevant to the study.

(3) Case studies of 10 alternative agriculture farms in Manitoba involving personal interviews with producers to collect information about the environmental and economic viability of the chosen farms.

Seven of the 10 farms qualified for the economic assessment, which included crop years 1986 and 1987. Use of the 'Crop Production Simulator', which is a computer program designed at the University of Manitoba (Department of Agricultural Economics and Farm Management), facilitated production of a cost return budget to arrive at net cash returns. Net cash returns are returns to the crop production enterprise, before labour and investment costs. Returns are presented on a per acre per crop basis and as a per acre farm average. Regular market prices for crops were used in determining net cash returns, regardless of whether or not the farmer was receiving a premium price by selling his crop as organic produce. At present a premium price is an option available to few farmers in Manitoba.

The basis of comparison representing conventional crop production, was derived from Statistics Canada and Manitoba Agriculture data. Statistics Canada performs surveys yearly to determine average crop yields of each crop district in Manitoba. The results of the survey, for 1986 and 1987, were used in this study, for those crop districts occupied by an alternative case farm. Manitoba Agriculture produces budgets yearly to estimate crop production costs. The yields together with the budgets enabled simulation of net cash returns per acre for several crops for each of 1986 and 1987. Agriculture Canada budgets and net cash returns prepared for 1987 provided another means of comparison.

Results

General Considerations - The main motivation of the alternative producers for reducing chemical and fertilizer use was concern over the health effects of using these chemicals, particularly on personal and family health. A number of other motivating factors were cited, which together illustrated a common thread among the alternative producers (i.e., a desire to farm in an efficient manner while at the same time maintaining the integrity of the soil and the environment, with production of high quality foods, and with minimal health risks from pesticides or fertilizers). Half of the farmers felt they were making financial sacrifices using alternative methods of agriculture, the other half felt they were not. The majority felt there was a serious lack of information available to farmers who want to farm without, or with reduced amounts of, chemicals and fertilizers. A number of suggestions were made by the producers as to what type of research or technical information they would find useful, such as weed competitive crop varieties, natural pest control methods, emphasis of the effects of contemporary farming methods on soil biology, and research into marketing of organic foods.

Environmental Analysis - Crop rotation programs varied in length from three to 10 years. Rotation of crops is beneficial for maintenance of soil productivity as compared to monoculture. Maintenance of soil fertility is particularly important to producers who do not rely on synthetic fertilizers. All but one producer had a legume incorporated into their rotation program. Nitrogen-fixing legumes provide nitrogen to the soil. Maximum benefit is acquired when the legume is treated as a green manure; harvesting for seed or forage removes most of the fixed nitrogen. As well, legumes used as a green manure or forage provide protective ground cover on the soil surface and organic matter to the soil. Organic matter serves as an important binding agent to soil aggregates, contributing to the soil's stability, and water infiltration capacity. Livestock manure was not widely used by the producers.

A number of weed control methods were used by the alternative producers including use of competitive crops, some herbicides, and cultivation. Many of the present soil degradation problems are considered to be the result of overcultivation. The producers, however, were more reliant on timeliness of cultivations, as opposed to amount of cultivation.

On average, alternative producers performed one fall tillage operation with a heavy duty cultivator and two to three spring operations. In most cases, the spring operations involved use of a light duty cultivator and/or harrowing. The producers' practices fit into the definition of a 'minimum tillage' system, as given in a Manitoba Agriculture study by Slevinsky (undated), also known as reduced tillage.

Economic Analysis - Cropland uses of most significance for alternative producers in both 1986 and 1987 were, in decreasing order, wheat, barley, oats and then summerfallow or plowdown, with flax, hay, peas, canola and lentils accounting for a very small proportion of the total acreage. Wheat and oats performed the best with regards to achieving levels similar to the respective crop district average yields.

Net cash returns per acre, expressed as a farm average, varied considerably between alternative farms and between years. The range between farms varied from profits of $0.74 to $33.31 per acre in 1986, and from a loss of $23.75 to a profit of $24.15 per acre in 1987. It is difficult to distinguish as to how much of this variation is due to locality differences in productivity of the land, or local weather patterns, or differences in management practices.

Of the crops grown by the alternative producers, hay obtained the best net cash returns per acre in 1986 and 1987. However, hay availability and, therefore, prices may vary considerably from year to year. After hay, the crops with the greatest net cash returns in 1986 were wheat and then oats, while in 1987 this was reversed. Compared to the representative net cash returns of each producer's crop district, using Manitoba Agriculture budget estimates, (representing conventional crop production) wheat returns per acre were on average 1.6 times greater on the alternative farms in 1986, and 3.1 times greater in 1987. Whereas all alternative producers had lower yields of barley than their crop district's average in both years, one of four alternative producers obtained better net cash returns than district averages for this crop in 1986 ($20.61/acre vs. $6.61/acre). For two of the four producers who grew barley in 1987, one had better net cash returns than his respective district average ($4.44/acre profit vs. $19.26/acre loss), and one did not experience as great a loss as his crop district average (losses of $0.80/acre vs. $19.26/acre). Flax net cash returns were inconclusive due to the small number of producers who grew flax (two in 1986 and one in 1987).

For those crops where net cash returns between conventional and alternative production could be compared, net cash return differences were not proportional to yield differences. For example, in 1987, four of the seven alternative farms growing wheat had yields lower than their district average, yet only one of seven had net cash returns for wheat lower than the respective district average.

Agriculture Canada budget estimates, for 1987, gave average net cash returns of $11.47 per acre for wheat compared to the alternative farm average of $19.58. Barley returns related to a loss of $25.19 per acre for Agriculture Canada estimates and a smaller loss of $15.28 per acre for alternative farm average. Flax net cash returns were inconclusive due to the small number of flax crops.

The unproportional differences between yields and net cash returns in the comparison to Manitoba Agriculture budgets and the differences in returns in the comparison to the Agriculture Canada budget can be explained by the lower cash production costs on the alternative farms. What appeared to keep cost factors of alternative farms down was the low input of fertilizers and pesticides. In comparing other costs, it appeared that fuel costs, machine investments and labour estimates for alternative farms were not greatly different from the conventional estimates.[1]

Two of the producers were selling their wheat as organic produce and were receiving a premium price. While Canadian Wheat Board prices for No. 1 Red Spring wheat were $3.18 per

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[1] Machine investments and labour costs are presented for comparison purposes. They were not used as a cost factor in determining net cash returns because they are not a cash cost.

bushel in 1986 and $2.64 per bushel in 1987, one producer received $5.28 per bushel in 1986 and $4.74 per bushel in 1987, and the other received $5.00 per bushel in 1987. These premium prices raised the former producer's farm average net cash return per acre from $33.31 to $84.05 in 1986, and from $21.73 to $71.81 in 1987. They raised the latter producer's farm average net cash return from $4.91 to $33.45 in 1987. At present, however, the organic market in Manitoba and Canada has not been developed enough to support a large number of organic producers.

Conclusions and Recommendations

The crop rotation program utilized by the alternative producers in this study would likely contribute to the soil stability of the various farms. Additionally, the alternative producers do not appear to be over-cultivating in most cases and in fact appear to be avoiding such practices as excessive fall tillage. They are also avoiding use of such tillage equipment as moldboard plows, which bury up to 90 percent of the crop residue. The producers are leaving an average of 70 to 80 percent of their crop residue on the soil surface overwinter, providing the soil with protection from wind and water erosion.

The large proportion of the total acreage among all the producers which is devoted to cereals, as compared to the small amount devoted to oilseeds and specialty crops, indicates that the farmers themselves feel they have more success with cereals. Oilseeds and specialty crops may have more stringent fertilizer requirements and/or may have greater susceptibility to weed and insect infestations.

It is difficult to make general statements regarding the performance of alternative farms in relation to conventional farms due to the large variation among the case farms. In 1986 and 1987, wheat and oats produced by alternative methods appeared to fare better than their conventional counterparts on average. Considering the performance of the alternative producers for the crops which could be compared to conventional crop production, it appears then, that for the two years of study, 1986 and 1987, some of the alternative producers fared as well, if not better than their conventional counterparts.

As a result of this study a number of recommendations were made.

1. Further research should be performed, including:

   - actual field studies on the effects of alternative farming on soil properties. This would involve comparisons of land farmed alternatively to land farmed conventionally. It would require examination of soils which had been farmed in their specific manner for various periods of time (for example 5, 10, 15 and 20 years). This would assist in determining the differences in soil properties, if any, which might be expected over time when farming alternatively.

- expansion of the present study over a minimum of five years to also indicate the profitability of alternative agriculture over the long-term.
- comparisons to actual conventional farms in comparable climatic regions and soil zones, to enable comparisons for the entire crop production enterprise, taking into account the costs of summerfallow or plowdowns.
- following one or more producers through the transition period from conventional crop production to alternative crop production to document the process. Following one or more established alternative producers in comparable climatic regions and soil zones, through the same time frame, would provide a valuable basis of comparison between the two stages.
- carrying the study into a time when market prices of crops have risen from their present depressed position, to determine how alternative agriculture fares under more 'normal' conditions.
- a whole farm analysis which included livestock and crop production enterprises to give an indication of returns to the entire farm enterprise.

- an examination of the potential of alternative farming for wildlife populations.
- studies which focus on conventional agriculture's contribution to nonpoint pollution in Manitoba, to give indications of the potential benefit of alternative agriculture as a means of reducing these pollutants.

2. An update of research studies and technical bulletins which originated prior to the chemical era should be performed. This material contains information concerning rotations of crops and nonchemical fertilization and pest control methods, which would be valuable to alternative and conventional farmers.
3. A resource person should be assigned to organize a network of communication between alternative producers. Duties would include, for example, organizing meetings, speakers, newsletters and farm tours. Such functions would provide both alternative producers and conventional producers with a means to acquire information on features of alternative agriculture. The resource person would serve to enhance the exposure and capabilities of alternative agriculture in Manitoba.
4. It is further recommended that governmental agencies work cooperatively with one or two alternative producers within Manitoba to establish these producers'

farms as demonstration farms. Demonstration farms would provide a vehicle to perform the previously recommended studies as well as to provide field days, tours and lectures to not only alternative producers, but also interested conventional farmers. The resource person mentioned above could assist in coordinating functions on the demonstration farms.

5. Marketing opportunities for organic produce should be explored in Manitoba. This would include determination of consumer interest in organic products and for what products, possible ways of introducing organic products into the market. (ie. through specialty stores or large supermarket chains), as well as how to assure quality control. This recommendation would be best taken up by private industry.

6. It is strongly recommended that any further investigations involve direct participation with alternative producers.

ACKNOWLEDGEMENTS

During the process of this study I was somewhat hesitant to 'bother' people, to ask them for information or assistance. I need not have worried, for everyone I encountered was more than willing to lend a student a hand. My only worry now is that I have so many to thank.

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Chapter I

INTRODUCTION

1.1 PREAMBLE

Canadian agriculture is being confronted with a number of problems which are resulting in a crisis situation. Farmers are receiving ever-decreasing returns for their produce while at the same time input costs are increasing. Soil degradation is seriously undermining the productivity of Canadian agricultural soils (Sparrow 1984). Concern as to the overall effects of synthetic chemicals on the quality of the environment and the food we eat is increasing (Madden 1987b). In addition, there is concern over the almost complete reliance of modern agriculture on nonrenewable resources for fuel, fertilizer and pesticide manufacturing (Roberts et al. 1979). These factors have led to the question of the long-term sustainability of present agricultural production practices (Youngberg et al. 1984).

There is a growing move, particularly in the United States, towards alternative agricultural systems. Alternative agriculture may "refer to a spectrum of low-chemical, resource- and energy-conserving and resource-efficient farming systems and technologies" (Youngberg et al. 1984). It may refer to a number of different systems including, for example, organic, biodynamic and regenerative farming. Sustainable agriculture, which is becoming a popular term within many segments of society, from agriculturalists to environmentalists, might be considered as one aspect of alternative agriculture. Proponents of such farming techniques consider them to be sustainable and ecologically harmless (Madden 1987a). The reasons for producer interest in such systems are varied and may include a combination of the following:

1. a perceived potential to decrease input costs of fertilizers and pesticides;
2. concern over the effects that use and handling of synthetic fertilizers and pesticides will have on personal/family safety and health;
3. concern over the loss of soil productivity which may result from many of the present agricultural practices;
4. concern over the potential impact of agricultural chemicals and fertilizers on various components of the environment;
5. desire to produce food products that have been grown in an environment relatively or completely free of synthetic chemicals; and
6. recognition of the potential market for such specialized products demanded by a public becoming increas-

ingly wary of foods produced with agricultural chemicals.

1.2 PROBLEM STATEMENT

A limitation to implementing alternative agricultural systems has been the lack of information for farmers to use in judging the relative merits of such approaches (Henkes 1985). This is particularly true for the Prairie Provinces, as available information is mainly from the United States and pertains primarily to corn and soybeans. In Manitoba, however, corn plays a relatively small role in crop production in comparison to cereal grains and oilseeds. For example, in 1986 wheat accounted for approximately $536 million, or 41.5 percent of Manitoba's total farm cash receipts for crops, while corn accounted for approximately $7 million or 0.54 percent (Man. Dept. Agric. 1988). Exploring the economic viability of alternative production systems for production areas which rely on grains and oilseeds will provide an indication of the potential for such systems on the prairies. To be truly sustainable, however, an alternative system must be environmentally viable as well. By examining alternative agriculture in Manitoba from an environmental context as well, three basic questions may be explored:

- What are the present and potential problems, particularly as they affect Manitoba farmers, that would induce one to change from conventional agriculture?

- Can these problems be overcome or at least diminished by alternative agriculture?
- As in any agricultural system, the bottomline is, can alternative agriculture be profitable to the farmer?

1.3 OBJECTIVES

The objectives of this study were to compare alternative farming systems to conventional systems in an economical and environmental context, with the former referring to economics at the farm-level. The study involved objective comparison of the following, using quantitative data where available:

- input requirements, including chemicals, fertilizers, fuel, machinery and labour;
- overall crop returns including crop yields and grades attained; and

Subjective comparison of the following, using qualitative data:

- soil and water conservation potential;
- pest problems such as weeds, insects and diseases, the control methods used and the environmental implications of these control methods;
- the environmental implications of decreasing use of agricultural chemicals and fertilizers.

1.4 DEFINITION OF ALTERNATIVE AND CONVENTIONAL FARMING

There are many methods of farming which may be embraced by alternative agriculture. According to Madden (1987a)

> There are no hard-and-fast definitions or categories for such "soft" concepts as alternative, sustainable, organic and regenerative agriculture. Technologies that are considered alternative today may become commonplace tomorrow.

Additionally, proponents and practitioners of alternative agriculture possess a wide spectrum of practices, activities and goals (Youngberg 1978) both among and within the various styles, which are not limited to the use or non-use of chemicals. Some alternative agriculture proponents, for example, are committed to the idea that farming should involve less mechanization and smaller farms than prevails at present (Youngberg 1978). This study was concerned primarily in agricultural systems which have reduced or eliminated the use of petroleum-based fertilizers and pesticides. Therefore, for the purpose of the study, an **alternative farmer** was defined as a farmer who has made a conscious decision to make a long-term commmitment to decreased chemical dependency. The result should be food and feed production without an over-reliance on synthetic fertilizers and pesticides.

There is a challenge in attempting to define a conventional farmer. An alternative agriculture system, as previously noted, is not limited to those where pesticides and fertilizers have been completely eliminated, but also includes those where such chemicals have been reduced to various levels. At what point, then, does a farmer make the transition from being labelled a conventional farmer to an alternative farmer? In this study a **conventional farmer** was defined as one who takes advantage of contemporary weed control and soil fertilization methods, and who has not made a conscious and long-term commitment to decrease his chemical dependency. Several other definitions of terms employed within this report are presented in Appendix A.

1.5 BASIC METHODOLOGY

The methods used for comparing alternative to conventional agriculture consisted of three phases. The initial phase involved a review of the literature pertaining to soil degradation and pesticide and fertilizer problems plus a more indepth review of alternative agriculture in relation to its financial productivity and its potential to positively affect the previous two problems. Some of the information for the subjective comparisons outlined in the objectives, was acquired through the literature review.

Secondly, informal contact was made with members of government, the agricultural industry and the academic community. Such contact was for the purpose of identifying the case studies described below, confirming the validity of the method of data analysis, and acquiring other information relevant to the study.

The third phase involved the collection and analysis of illustrative case study data for alternative farming systems. Crop production on ten alternative agriculture farms in Manitoba were compared to conventional crop production. Quantitative and qualitative data were analyzed regarding the economic and environmental implications of crop production by alternative methods in Manitoba.

For conventional crop production, yield information was obtained from Statistics Canada crop district averages, and cost of production information was derived from Manitoba Agriculture budgets. Budget and return indicators estimated by Canada Agriculture for 1987 provided another means of comparison. Economic comparisons were made based on net cash returns for several crops and by comparing relevant cost of production factors. Environmental comparisons were made through subjective information acquired through the case studies and through the literature as described above.

Chapter II

REVIEW OF RELATED LITERATURE

Alternative agriculture covers a spectrum of agricultural systems including organic, biodynamic, natural, biological, ecological, regenerative and sustainable (Madden 1987a). Most of these systems possess similar characteristics in that there is a move towards non-chemical modes of pest control, as well as maintenance of soil fertility through natural sources, primarily manures and legumes. According to Madden (1987a) regenerative and sustainable agriculture add further requirements in that

> to be truly sustainable and regenerative from generation to generation, the farm must earn a level of profit acceptable to the farmer as a return on his or her labour, management, risk bearing, and capital...(and)...includes the ultimate goal of prosperous and debt-free farming, in contrast to the seemingly perpetual state of indebtedness many people consider "normal", "modern" and "smart" farm management strategy.

Alternative agricultural practices are considered to be sustainable to the degree that they are not as dependent on price fluctuations of nonrenewable resource based inputs, and that they do not deplete these resources to the extent that conventional systems do (Youngberg et al. 1984). Also, such systems are thought to maintain productivity of the land to a greater degree, such that it will sustain agricultural production for future generations.

2.1 ENVIRONMENTAL CONSIDERATIONS

2.1.1 Soil Conservation

This section discusses the nature of the problems in soil conservation and how alternative agriculture might affect these problems. Included is some discussion on maintenance of soil fertility. The purpose of this, as will be seen, is that many of the non-chemical means of maintaining soil fertility also contributes to soil stability, so that the soil is less susceptible to erosion. The movement away from non-chemical means of maintaining soil fertility, is in fact part of the cause of the need for soil conservation measures.

2.1.1.1 Nature of the Problem

In the 1984 Senate Report 'Soil at Risk' (Sparrow 1984), soil degradation was cited as being the most serious agricultural crisis in Canadian history. Soil degradation on the prairie provinces is mainly the result of erosion by wind and water, loss of organic matter, salinization, impairment of soil tilth and in some areas soil acidification (Bentley and Leskiw 1984). A soil's susceptibility to erosion depends on a combination of physical, topographical, climatological and cultural factors, such as soil texture and moisture, slope of the land, rainfall or runoff intensity, frozen layer beneath the surface soil, tillage tool used and the amount of protective crop residue left on the soil surface (Dumanski et al 1986; Sparrow 1984).

Although soil degradation has been receiving a lot of attention in recent years, it is not a new phenomenom. Soil conservation has been recognized as a requisite to good farming practices on the Prairies since the early 1900's (Dumanski et al. 1986). The need was particularly felt during the debilitating droughts of the 1920's and 1930's.

As a consequence of various modern agricultural practices (Dumanski et al. 1986; Coote et al. 1982) encouraged by federal and provincial priorities for increased production (Sparrow 1984) and compounded by the high winds and dry soils characteristic of the prairies (Dumanski et al. 1986), soil degradation has resurged as a foremost problem for agriculture on the Canadian prairies.

Monoculture has been widely accepted to the resultant exclusion of legume-based crop rotations (Youngberg et al. 1984). Rotations of crops is advantageous for several reasons (Gorby 1959):

- by diversifying and growing several crop types each season, the farmer will be better equipped to deal with crop failure, low prices or glutted markets, for certain crops,
- soil productivity is better maintained,
- labour is more evenly distributed through the season
- better control of diseases, weeds (and insects).

Legumes used in crop rotations provide nitrogen through nitrogen fixation. Most of this nitrogen is removed if the legume is harvested for seed or forage, so that maximum benefit from the fixation is acquired if the legume is used as a green manure (Bailey 1987). Legumes which are treated as a forage or green manure are left on the field for more than one year providing protective ground cover. Plus, some legumes produce large quantities of vegetative growth, providing organic matter to the soil (Bailey 1987). Organic matter serves as an important binding agent to soil aggregates, contributing to the soil's stability, and water infiltration and aeration capacity (Dumanski et al. 1986). Soils deficient in organic matter are more susceptible to the erosive actions of wind and water as well as to compaction from tractor tires (Arden-Clarke and Hodges 1987). Additionally, as organic matter declines, the soil humus loses its ability to provide nitrogen, necessitating additional inputs of fertilizer nitrogen (Bentley and Leskiw 1984). Loss of organic matter in prairie soils has been estimated to be anywhere between 40 and 60 percent of what it was when these soils were first brought under cultivation (Dumanski et al. 1986; Hedlin 1984). When land is continuously planted to crops, the loss of organic matter exceeds its replacement. This occurs even when inorganic fertilizers increase crop yields, with a corresponding increase in straw yields, the latter being a potential organic matter supply (Arden-Clarke and Hodges 1987).

There has been an overall reduction in livestock farms with a concomitant decline in pasture land and forage crops, both of which are good soil stabilizers (Coote et al. 1982). The practice of spreading manure over fields as a source of nutrients and organic matter has correspondingly declined. In addition, soils better suited to pasture or forage are cultivated and exposed to erosive agents (PFRA 1982).

Soil sediment loss from farm fields not only reduces the productivity of the soil, but the sediment itself as well as pesticides and fertilizers which may be associated with the sediment, are agents of a major form of pollution known as nonpoint pollution (Baker and Laflen 1983). Other contributors to nonpoint pollution include pathogenic bacteria, acid rain, polychlorinated biphenyls, as well as pesticides and fertilizers not adsorbed to sediment (Chesters and Schierow 1985). According to Chesters and Schierow (1985), at least half of all water pollution is the result of nonpoint pollution, and the greatest contributor to nonpoint pollution is apparently soil sediment.

The spreading problem of soil salinization on the prairies has been assessed by some as the main cause of the degradation of prairie soils (Coote et al. 1982). Dumanski et al. (1986) on the other hand note that although salinity is a serious problem, the "extent, severity and dynamics of dryland salinity on the prairies has not been agreed upon". As explained by Barclay (1987) this condition occurs when

> moisture in excess of crop requirements percolates below the root zone in the recharge area, flows downstream picking up salts as it goes, and eventually reaches the surface again as saline seeps in low-lying spots.

The South-western plains of Manitoba are considered to be one of the areas of Western Canada more severely affected by salinization (PFRA 1982). Production losses due to salinization on the Prairie Provinces were estimated at $257 million for 1982. Saline areas were further estimated to be increasing by approximately 10 percent per year, relating to an additional $26 million a year (PFRA 1983). A major contributor to this problem is considered to be the practice of summerfallowing, which raises water tables, transporting salts to the surface (PFRA 1983). Summerfallowing also accelerates the decomposition of organic matter, contributing to wind and water erosion (Dumanski et al. 1986).

2.1.1.2 Alternative Agriculture and Soil Conservation

Many of the practices considered as good soil conservation practices are also essential components of alternative agricultural systems (Madden 1987a; McMullen and Durance 1985). For example, in organic farming systems, a large role is played by crop rotations, crop residues returned to the soil, animal manures, legumes and green manures to name a few (USDA 1980). In a survey by Robinson (1983), involving ecological-organic and conventional producers from Manitoba, crop rotations of both groups appeared very similar.

The biggest difference was that 64 percent of the organic group utilized a green manure crop compared to six percent of the conventional group. Green manures, which are crops grown to be turned under, protect fallow fields from erosion and add organic matter to the soil, as well as nitrogen in the case of leguminous green manures (Hanley 1980). Alternative agricultural systems are much more dependent on such sources and animal manures for nitrogen.

In a study by Reganold et al. (1987), soil which had been farmed organically since it was first cultivated in 1908 was compared to that on an adjacent matched farm which had been using recommended rates of fertilizers and pesticides since 1948. Soil samples on the organic farm fared significantly better in the following:

- organic matter
- binding agents important for soil aggregate formation
- moisture content
- thicker topsoil

The thinner topsoil on the conventional farm was "attributed to significantly greater soil losses due to erosion on the conventionally-farmed soil between 1948 and 1985" (Reganold et al. 1987). The conventional farm had a soil loss of 32.4 ton/ha. (13.1 ton/acre) as a result of water erosion, compared to 8.3 ton/ha. (3.4 ton/acre) on the organic farm. The authors suggested that the use of a leguminous green manure in the rotation system of the organic farm rendered it less susceptible to erosion.

Similarly, in one phase of a series of studies at Washington University,[2] soil samples taken from 35 pairs of organic and conventional farms showed a significantly higher percentage of organic carbon in the organic fields (Lockeretz et al. 1978).

It is generally assumed that because organic farms cannot depend on herbicides and insecticides for pest control, more cultivation is required. Excess cultivation however, can cause an assortment of soil degradation problems. In Robinson's (1983) study, cultivation practices were very similar between organic and conventional producers, with both using mainly a chisel plow type of implement as opposed to the moldboard plow, the latter of which buries approximately 90 percent of the protective crop residue (Man. Dept. Agric. 1986a) Similarly, the organic farmers in a United States Department of Agriculture (USDA 1980) study, most commonly used a chisel or disk-type implement. In Robinson's study, organic and conventional producers performed the same number of cultivations from stubble in the fall to spring planting, although the organic farmers did a greater proportion of their total cultivations in spring as a form of weed control. Lockeretz and Wernick (1980b), using fuel consumption as a rough measure of cultivation, found that organic farms

[2] At the Centre for the Biology of Natural Systems (CBNS).

used 14 percent more fuel per acre of corn for seedbed preparation and cultivation, than the conventional farms, but that they utilized reduced tillage methods to a greater degree. The authors do not, however, indicate why it is the organic farms utilize more fuel, despite the fact they practice reduced tillage.

In the USDA (1980) study, 69 case studies of organic farms in the United State revealed that soil and water conservation techniques commonly used were terracing, grass waterways, stripcropping, and contour farming. In a study for Agriculture Canada (McMullen and Durance 1985) organic farmers across Canada were surveyed. Of 21 prairie farmers, 14 stated that they used some erosion control practice. The main soil improvement techniques for all the farmers in that survey were, in descending order, animal manure, crop rotation, and green manures. These types of practices are essential to organic farmers as a means of fertilization, and at the same time, they improve soil stability, thus rendering the soil less susceptible to agents of erosion.

2.1.2 Water Conservation

Large portions of the Prairie Provinces experience soil moisture deficits as a result of our climate (PFRA 1982). Some of the techniques common to alternative agriculture such as rotations of crops, help to ameliorate this somewhat by adding organic matter to the soil, improving it's infiltration capacity (USDA 1980). Also, reductions in tillage, where applicable, has some water conserving potential, depending on the extent of the reductions. On the other hand, use of deep-rooted legumes as used in most alternative systems, consumes water and may result in a water deficit particularly in drier areas. Coxworth and Thompson (1978) found that wheat following clover on a Saskatchewan organic farm experienced reduced yields. Part of this reduction, however, was due to heavy crop residue cover from the clover, making seeding very difficult (Coxworth and Thompson 1978). The heavy clover residue could also have indicated that the clover had been left too long into the previous summer before it was turned under as a green manure, therefore consuming a greater amount of water and also more of the fixed nitrogen.

2.1.3 Effects of Agricultural Pesticides and Fertilizers

2.1.3.1 Pesticides

There has been a good deal of debate regarding the risks and safety of various agricultural chemicals. It is now recognized that certain chemicals do pose a threat to environmental, animal and/or human health, for example DDT and aldrin (Gianessi 1987), while others are now receiving the heat of the debate, as with 2,4-D (Schneider 1983) and alachlor (Man. Coop., 1986a and 1986b). Most of the remaining are considered comparatively harmless by their advocates, provided they are handled properly and used as recommended. Nevertheless, there is increasing concern among the general public and the agricultural sector, for various reasons, over the heavy reliance of modern agriculture on such chemicals.

There are concerns that information is lacking for some pesticides which were approved for use prior to the implementation of current standards (Schrecker 1984). Also, the inability of scientists to agree over the results and adequacy of laboratory evidence, as in the 2,4-D debate (Schrecker 1984), may serve to further alienate the public against agricultural chemicals. A considerable amount of time and resources is required to test pesticides for the variety of potentially possible effects. For example, of 600 pesticide active ingredients under review by the United States Environmental Protection Service (EPA), only two have received final assignment of conditions of use and crops on which use is approved (Gianessi, 1987).[3] According to Gianessi (1987), of the others

> seventy-nine have been cancelled voluntarily or have been suspended by EPA . . . . All of the remaining are at some interim stage of the reregistration process.

The difficulty in testing pesticides is the result of the inherent complexity of the interactions of them and their breakdown products with the various components of the natu-

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[3] Under the 1972 amendments to the U.S. Federal Insecticide, Fungicide, and Rodenticide Act, EPA is required to reregister all pesticides which were in use prior to current testing requirements (Gianessi 1987).

ral and manmade environment. As a result, hazardous effects may not be detected or related back to the cause for years after their initial introduction, if at all (Hinkle 1983).

When pesticides and/or their breakdown products move beyond their intended target the result may be contamination of surface water, groundwater (Chesters and Schierow 1985) the soil, vegetation or the resultant food products. As well, direct exposure may cause hazards to the users themselves; the farmer, his family or farm workers. The fact that pesticide fates are most frequently determined under controlled conditions of the laboratory, plus the weak understanding of the mechanisms by which organic chemicals are transported from soil surface to, for example, groundwater (Jury et al. 1987) are two factors which further serve to create suspicion. Seepage of pesticides into the groundwater has become a reality in various areas across the United States (Chesters and Schierow 1985) prompting most states to develop groundwater protection strategies (Gianessi 1987).

Hallberg (1986) notes that most previous studies of pesticides in groundwater have only looked for the pesticide compound and not the breakdown products which "may be as toxic or even more toxic than parent products." The potential for groundwater contamination is greater on irrigated land; pesticides have been identified in groudwater on at least one irrigated farm in Manitoba (Krawchuk and Webster 1983).

Muir and Grift (1987) conducted a monitoring survey on two rivers in Manitoba to determine levels of seven herbicides. No herbicide was considered to be at high enough levels to deleteriously affect fish or their food organisms. A final conclusion by Muir and Grift (1987) was, however, that

> there appears to be no published literature on the aquatic fate or chronic effects on biota of triallate, bromoxynil or dicamba. This situation is surprising given the continued wide use of these compounds in Western Canada.

Bromoxynil and dicamba are generic names for several broadleaf herbicides and triallate is the generic name for a wild oat herbicide. All are popular herbicides in Manitoba.

It is the potentially acute and chronic effects on the natural environment and humans, from these forms of contamination, which are the central feature of the agricultural chemical debate.

Consumers are also becoming increasingly wary about the quality of foods produced with the assistance of agricultural chemicals. In a 1987 survey by the Food Marketing Institute of Washington (Puzo 1987), 76 percent of those surveyed thought that "pesticides and herbicides continue to pose a major threat to food supplies". This trend towards public awareness of food quality is not limited to North America and in fact is, if anything, stronger in areas of Europe (see Farmers Guardian 1986).

There are several other real problems with pesticides, one being the growing resistance of many pest species to the present battery of pest control chemicals. According to Dover and Croft (1986) resistance to one or more pesticides has been developed by 428 arthropod species, 150 plant pathogen species and 50 weed species. Another problem is that pesticides kill beneficial organisms, such as the predators of pest species, necessitating further pesticide input (Wagstaff 1987). Researchers are attempting to counteract the first problem by 'resistance management' which attempts to "prevent, delay, or reverse the evolution of resistance" (Dover and Croft 1986). There is also research into integrated pest management systems, which involves integration of a number of methods to obtain optimum control. Integrated pest management includes "use of resistant crop varieties, beneficial organisms, crop rotations, and chemicals where necessary" (Hinkle 1983).

2.1.3.2 Fertilizers

The plant nutrients, phosphorous and nitrogen, are apparently second after sediment as contributors to nonpoint pollution, contaminating surface waters (Chesters and Schierow 1985), as well as groundwater (Zahradnik 1983). These nutrients originate from agricultural sources, as in fertilizer use on cropland and manure in livestock farming, as well as from urban sources, such as sewage wastes (Schlinder 1978) or runoff from lawn and gardening fertilizers (Chesters and

Schierow 1985). Increases in nitrate levels in groundwater has been found to be associated with the increased input of fertilizer nitrogen (Hallberg 1986; Zahradnik 1983). This is apparently largely due to the fact that only about 36 percent of the nitrogen applied as fertilizer is actually used by the crop for which it was intended (Zahradnik 1983). One known health effect of nitrate is that it converts to nitrite when ingested reacting with hemoglobin, thereby decreasing oxygen transport (Baker and Laflen 1983). This is particularly hazardous to babies under six months of age, causing methemoglobinemia or 'blue baby' (Zahradnik 1983).

2.1.3.3 Alternative Agriculture and Agricultural Chemicals

The majority of farmers surveyed by Robinson (1983) perceived organic farming to be healthier for the farmer and his family (72, 82 and 80 percent for conventional, organic and transitional farmers respectively). It is not known how much land in Manitoba is under some form of alternative agriculture, or for that matter in Canada, but it is likely small in relation to the total amount of cultivated land. At present then, it is not likely that alternative agriculture significantly lowers the amounts of chemicals used in Agro-Manitoba. On an individual basis however, it may contribute benefits to the ecosystem of the farm itself (Cacek 1984) as well as reduce or eliminate risks to the farmer and his family from chemicals. In addition, if the farmer sells his product through special markets, he is providing a desired food product to chemical wary consumers willing to pay the extra price.

2.1.4 Motivations for Farming Alternatively in Relation to Environmental Effects

The importance that practitioners of alternative agriculture place on aspects of soil conservation and the potential effects of agriculture chemicals is revealed in their reasons for adopting their particular system. In another phase of the CBNS studies, 155 of 174 organic farmers surveyed responded that they had at one time farmed conventionally. Regarding their motive for switching, three quarters cited problems with conventional farming, such as soil problems, concern for personal, family or livestock health, or cost or ineffectiveness of chemicals (Wernick and Lockeretz 1977; Lockeretz and Wernick 1980a). In Robinson's (1983) study the most frequent reason cited for switching to organic was for long term sustainability of agricultural production, which included concern for soil conservation and environmental protection. This topic of motivations for farming in an alternative manner is dealt with more in-depth in a number of surveys performed both in Canada and the United States. Interested readers should refer to McMullen and Durance (1985), Robinson (1983 and 1986), Wernick and Lockeretz (1977) and USDA (1980).

2.2 ECONOMIC CONSIDERATIONS

The acceptance and adoption of sustainable farming practices is ultimately dependent on the financial productivity of such practices at the farm level. A number of studies have been performed employing various methods of analyses comparing organic to conventional crop production. A brief summary of such studies is given below. Although the present study is not necessarily limited to organic production, such a production system is at one of the extreme ends of the spectrum of chemical use, such that studies regarding them make worthwhile contribution to the determination of the viability of alternative agricultural systems.

2.2.1 Previous Studies

The results of a series of CBNS[4] studies which began in 1974 refuted claims that organic farming was merely a return to farming as it was 40 years ago (Wernick and Lockeretz 1977). Fourteen commercial mixed organic farms, varying in size from 175 to 844 acres (70.8 to 341.6 hectares)[5] were matched to conventional farms similar in size, soil type and livestock inventories in the midwest cornbelt of the United States. The economic performance and energy consumption of crop production in the two groups was compared for crop years 1974 and 1975 initially (Klepper et al. 1977), as well

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[4] Washington University, St. Louis, Mo.

[5] Range for acres/hectares of the total farm which was utilized as cropland was 113 to 420/45.7 to 170.

as for 1976 in a later study (Lockeretz et al. 1978). Further data were collected in 1977 and 1978 from 23 and 19 organic farms, respectively. In this latter phase, representative conventional production which formed the basis for comparison was county yields and USDA crop production budgets (Lockeretz et al. 1981).

Organic yields were lower than conventional yields in every year. From 1974 to 1977, however, the operating costs were lower for organic production in proportions similar to yield differences. As a result, organic net returns were greater in three of the four years. The difference was not large and in fact, income above operating costs for organic and conventional production were within four percent of each other for each of the four years. In 1978 however, conventional production outyielded organic to such a degree that returns were an average of 13 percent lower in organic farms (Lockeretz et al. 1981). Operating costs included fertilizers, pesticides, soil amendments, labour, fuel, lubrication, equipment repairs, seed, and crop drying (Klepper et al. 1977, Lockeretz et al. 1981). As fixed costs were assumed to be similar, returns were compared as income above variable or operating costs.

The greater yield advantage of conventional production in 1978 was speculated as being the result of that year's very good weather conditions relative to the previous study years, enabling greater yield response to chemical inputs (Klepper et al. 1977; Lockeretz et al. 1984).

Averaging the returns for the five years of the total study time was not considered appropriate due to differences in sample selection and analysis between the two sets of studies; 1974-76 and 1977-78 (Lockeretz et al. 1981). The average net return from 1974 to 1976 was equal for the two groups ($134/acre)[6] but organic was lower than conventional for 1977-1978 ($126/acre vs. $134/acre). In regards to study years 1974 to 1976, Klepper et al. (1977) noted that due to the variation between each group the results indicate no more "than a qualitative relation between crop production returns on the entire populations of the two kinds of farms in the Midwest." The general conclusion was that as growing conditions decline, the profitability of organic production meets and can, in fact, surpass conventional production based on the results of the five years of study (Shearer et al. 1981). It was also noted that even under extremely favourable conditions, the net return advantage of conventional production is modest (Shearer et al. 1981).

In another study, Berardi (1978) examined the energy and economics of organic versus conventional winter wheat production. Economic costs were 29 percent lower while energy inputs were 48 percent greater for the conventional farms compared to organic farms. Economic costs, including opportunity costs were $146.06 and $103.89 per acre for organic farms and conventional farms, respectively. Charges on land use and labour were included as opportunity costs, these

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[6] 1 acre = .4047 hectare

being the "income foregone by not investing in the next most profitable enterprise" (Berardi 1978). As most of the organic farms were located near towns, their land values were higher than those of the conventional farms. When opportunity costs were excluded, the production costs were then lower on organic farms at $47.10 and $61.98 per acre for organic and conventional farmers, respectively. Per acre yields were 44 bushels/acre for conventional and 34.2 bushels/acre for organic production. Returns were an average of $24.08 per acre for conventional farms and $5.89 per acre for organic farms when opportunity costs were included. When opportunity costs were excluded, returns became $65.99 per acre for conventional farms and $104.85 per acre for organic farms.

In a 1977 study by the Saskatchewan Research Council, energy consumption on seven organic Saskatchewan farms was compared to that on 'best-matched' conventional farms (Coxworth and Thompson 1978). Yields and variable costs were also considered and it was found that net returns over variable costs were better for conventional production on five of seven farm pairs. Returns were presented in graphical form only; no exact dollar value of returns were given. The authors noted that many of the organic farmers in this study were in the transitional stages and that therefore

> this study should be thought of as a comparison of the pioneer stages of organic farming compared with better established and more conventional farming methods.

Roberts et al. (1979) also analyzed the economic viability of organic crop production in the western cornbelt of the United States.[7] In their study a sample group of fifteen organic farms were treated as a series of case studies. Data from these farms were compared to USDA compiled data of conventional agricultural production, utilizing the data for each production area represented by a case study.

Yields between conventional and organic production, averaged over four years, were very similar for corn, soybeans and wheat (wheat was 34 bu/acre for both) while organic production performed considerably better for oats (64 vs. 47 bu/acre). An average of the income above variable costs (preharvest and postharvest expenses) was greater in organic production for all four crops. Even returns to overhead and risk (after total costs were deducted) were greater in organic production in the majority of areas for the various crops. Total costs included ownership costs, charges to land and management, plus variable costs. The overall conclusions were that the data indicated organic farming to be a competitive alternative to conventional farming.

[7] Included the states of Illinois, Iowa, Kansas, Missouri and Nebraska.

2.2.2 Limitations of Previous Studies

One of the limitations of all the previous studies presented was the lack of whole farm analysis to give a picture of the overall performance of the organic farms. This was acknowledged by some but was considered the best route for various reasons: time and resource restrictions (Roberts et al. 1979); differences between organic and conventional farming are mainly in crop production (Klepper et al. 1977; the study was a preliminary study into the economics of organic farming (Berardi 1978).

Another limitation in all studies was the small sample size. The weakness of small sample size is intensified when significant variation occurs in the results of each group. This was found to be true in the CBNS studies and led Klepper et al. (1977) to conclude that the results indicate only a "qualitative relation" for crop production returns between organic and conventional farming.

Berardi's results are weakened by the fact that seven of the organic farms were located in Pennsylvania and three in the state of New York, but all 10 conventional farms were in New York. New York wheat yields are an average of 7.8 bushels/acre greater than in Pennsylvania (Berardi 1978).

Use of USDA aggregate data in the study by Roberts et al. (1979) for representative conventional data was considered to be very general but the best data available (Roberts et al 1979). A further limitation in the Roberts et al. (1979) study was that production cost data was collected for one year only, therefore reflecting no yearly variations in growing conditions.

2.2.3 Further Study Requirements

The preceding sections discussed soil degradation problems on the Prairie Provinces, plus the concern that the uncertainty and risk involved in agricultural chemical use is prompting in many segments of society. Alternative agricultural systems have the potential to positively affect both of these conditions. As well, several studies have demonstrated comparable net returns between conventional and organic farms, at least over a limited period of time and in certain geographical regions.

Although the number of studies regarding alternative agriculture is increasing, there is still a lack of information, particularly concerning the economic potential of such systems in the Prairie Provinces. Investigations of that nature would serve, not only to contribute to the growing data base on alternative agriculture, but also to assist farmers who may be interested in acquiring information on the economics of alternative ways of crop production.

Chapter III

CASE STUDY METHODOLOGY

3.1 IDENTIFICATION OF CASES

Alternative agricultural producers were identified mainly through a directory of sustainable farmers, compiled in a previous Agriculture Canada study (Robinson 1986) which embraced British Columbia, Alberta, Saskatchewan, Manitoba and Ontario. Of the Manitoba producers identified as practicing sustainable agriculture, 28 had indicated that grains and/or oilseeds were incorporated into their system. Since this was the main area of interest for the present study, these producers were used for selection of participants. Of the 28 alternative producers, 12 were chosen to be contacted to determine if they qualified and if they were willing to participate. These 12 were selected based on the information given for each in the Agriculture Canada survey (ie. size of operation, whether or not they were farming alternatively at present, whether or not they indicated a willingness to participate in research studies). Those to be contacted were located primarily in the western part of agro-Manitoba, but three were situated south of Winnipeg. Eleven of the twelve could be contacted, the study was explained to them and it was determined if they met the criteria. Of the remaining 11, nine agreed to participate and an interview was arranged.

In addition to identifying producers in the preceding manner, names were acquired through the provincial agricultural representatives. Approximately 70 percent of the representatives were contacted, and after a description of the study were asked two questions:

1. Did they know of any such farmers?
2. Were they receiving any requests from farmers in general for information regarding farming with less chemicals?

Most names acquired from agriculture representatives had already been identified through the Agriculture Canada survey. For this reason, no further attempt was made to contact the remaining 30 percent of the representatives. One additional producer was, however, identified and he was subsequently contacted and agreed to participate. This gave a total of 10 producers interviewed; the approximate locations of each, as well as the crop reporting districts of Manitoba, are indicated in Figure 1.

Producer interviews required approximately three hours and were performed by the researcher with the standard questionnaire presented in Appendix B. A summary sheet explaining the purpose and objectives of the study was left with each participant (Appendix C) and each will be sent a summary of the results.

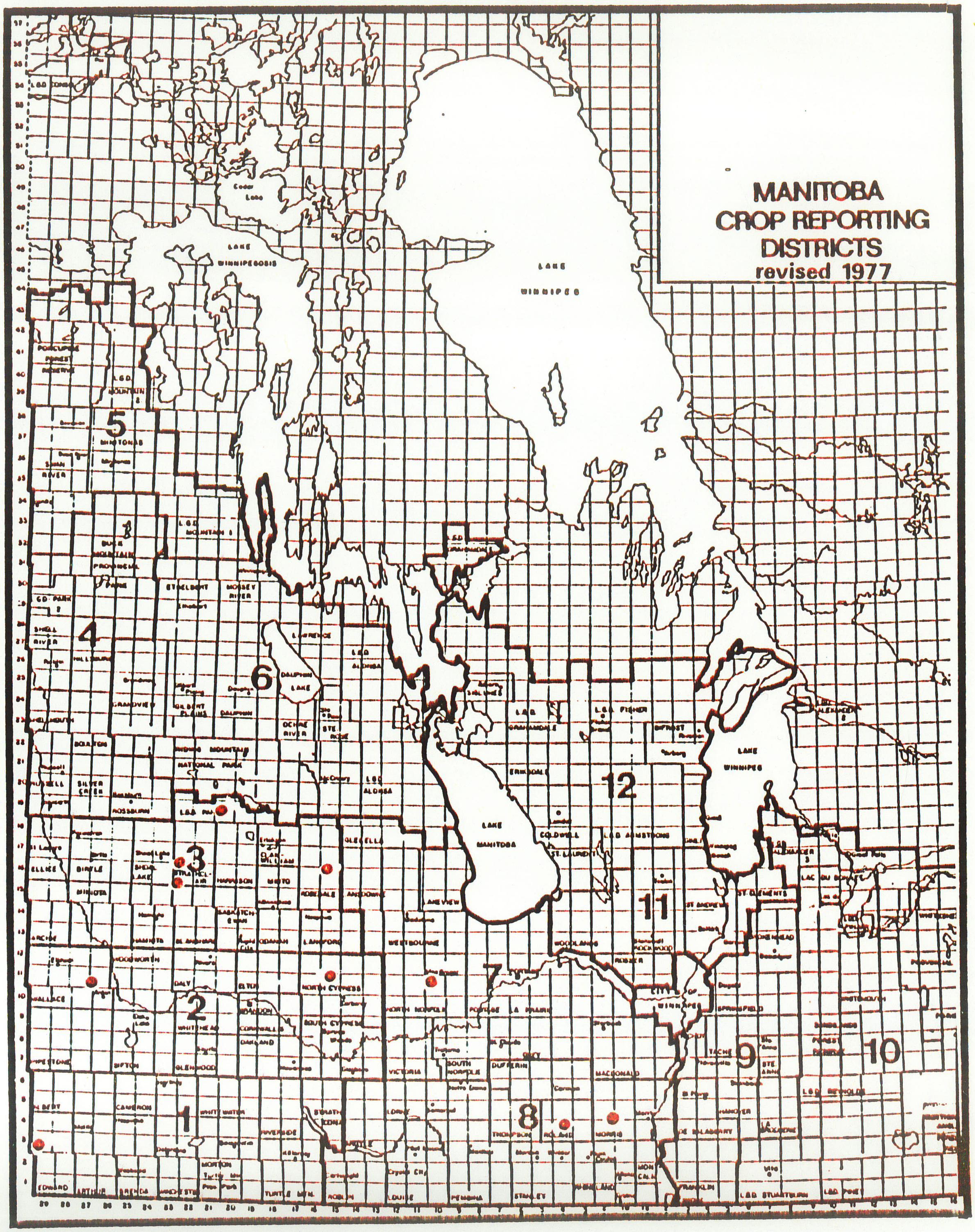

Figure 1: Crop Reporting Districts of Manitoba, and Locations of Alternative Farms Participating in the 1986-87 Study.

3.2 CRITERIA FOR SELECTION OF CASES

The following criteria were used for choosing cases for this study. Producers must have been practicing their particular form of alternative crop production for four to five years. This was to ensure that the producer was not merely cutting back on chemicals for a few years while product prices are low and that s/he has gone through the transitional phase of adopting an alternative system. Robinson (1983) found the average length of transition, from conventional farming to ecological-organic farming, to be 5.7 years in Manitoba.

A further requirement was that the producer have all the required information readily available. It was also originally suggested that participants be judged as competent farm managers. This is obviously extremely difficult without an indepth analysis. Such an analysis would involve establishing a set of standards by which to judge, which in itself would be a difficult task. Therefore, the criterion used was that if the producer had managed to remain in farming during these past years of severe agricultural stress, he was then, eligible to participate.

3.3 PROJECT SCOPE

Resources were not available for carrying out a whole farm comparison of the financial situation of alternative and conventional farms. For this reason and since this is a preliminary study, it was decided to focus only on costs and returns of crop production. As noted previously this approach was used successfully by a number of studies and, therefore, should be adequate for the purposes of this study.

Crop production information was collected for 1986 and 1987. Although 1985 data collection was originally planned if feasible, it became clear quite soon in the study that adequate data was not available in every case. Therefore data collection was limited to 1986 and 1987.

Cropland was defined as any land which was incorporated into the farmers rotation program including cropped land, green manure, summerfallow, or hay crops. Land used solely for permanent pasture or hay production was not included.

3.4 QUESTIONNAIRE FORMAT

The questionnaire was divided into four sections to gather the information as outlined in the following paragraphs.

Crop production data were used to help determine an individual producer's net cash return for the particular crop year in question. This included such information as acres per field, machinery owned, rented or custom hired, crops grown, yields and grades received, seed information, pesticides, fertilizers and any other soil condiments used, field operations, as well as market channels and prices received for produce.

Soil conservation information was collected to give an indication of the producers' understanding of soil conservation issues and to determine what, if any, measures were taken on their land with regards to soil conservation. Crop rotation and tillage information was also useful in inferring the various systems' effects on the soil.

The Producer Attitudes section was to assist in determining why sustainable agriculture was attractive to the farmer and what emphasis he placed on environmental considerations. It also was used to indicate what problems the producer experienced in trying to farm with either reduced or no chemicals as well as any changes planned for the future.

The Producer Profile was to collect background information on the producer and his farm enterprise.

3.5 FINANCIAL DATA ANALYSIS

Crop production information was used to produce crop enterprise budgets for each operation for 1986 and for 1987. This was facilitated by a 'Crop Production Simulator' model. The model is a computer program designed by the Department of Agricultural Economics at the University of Manitoba. As described by Longmuir et al. (1978):

> This particular model employs a producer's physical input data....together with average pricing techniques to arrive at a cost and return account for each crop produced. A total cost and return summary is computed and a total cost per acre summary is also printed.

An example of the crop simulator output for one alternative farm, is presented in Appendix D. Input cost calculations as computed by the model are explained in detail in Longmuir et al. (1978). Cost calculations rely on an annual update of appropriate prices for such items as fuel and lubrication, chemicals and fertilizers, land values and taxes, labour, interest rates, overhead and seed costs. For 1986, most input prices had been updated by Department of Agricultural Economics staff. Product prices for 1986 and 1987, as well as input prices for 1987 were acquired and updated by the researcher. Product prices for cereals were obtained from the Canadian Wheat Board and adjusted to reflect the price the producer would receive at the elevator. Flax and canola prices were obtained from the Canadian Grain Commission, and field pea prices from Manitoba Pool. Hay prices were averages of the prices advertised by producers in the

Manitoba Co-operator. Remaining crop prices were obtained from the producers themselves. For several 1987 input prices such as overhead, fertilizer and taxes the 1986 price was indexed using Statistics Canada's (1987) Farm Input Price Index. The remaining (seed prices, fuel prices, interest on operating capital) were sourced through the appropriate market.

All land was treated as though it were owned by the producer, although this was not always the case. The study was concerned with the production related activities of alternative agriculture for 1986 and 1987 and not with a complete cost accounting of each producer.

There was no attempt to determine if any labour was hired as this is most often a factor of whether or not there are sufficient numbers of family members available. Labor time required for each field operation was computed by the model according to the hours of operation for each implement and estimated labour time required to prepare, transport, operate and maintain the implement. The model then sums labour time for each field and multiplies it by hourly labor costs to arrive at total labour costs. Taking advantage of the model's estimate provided a uniform method of estimating labour. It would have been a difficult task for the farmers to attempt to estimate something as nebulous as labour time.

Fuel and lubrication costs were also computed by the model according to equipment used and number of field operations carried out with each. Repair costs were a factor of equipment age and actual field operations. Year manufactured, year purchased and beginning of year values were provided by the producers for 1986. The model depreciates equipment and provides end of year values which were then used for beginning of year values for 1987. One producer chose not to supply values and in his case computer supplied values were used. If a producer was not sure of a piece of equipment's year manufactured or year purchased, an estimate was made taking into consideration the age and purchase date of his other equipment.

There are a number of other particulars which should be noted:

- When a producer used clover as a green manure, which usually involves seeding the clover one year with a nurse crop and turning it under the next year, the clover seed and seeding costs were charged to the year of the plowdown. Furthermore, when a crop was underseeded with a nurse crop in one operation, the seeding operation was charged to the nurse crop.
- Field operations were to include those performed after harvest of the previous year, up to the end of harvest of the year in question.

- All summerfallow operations were charged to the summerfallow year regardless of whether any of the operations were performed that fall. For this reason it was also attempted to clarify which crops were being seeded onto a field which had been summerfallowed the previous year. This was to ensure that fall operations would not be charged twice (ie. charged to the summerfallow one year and to the crop the next year).
- Producer's that used their own seed were charged a commercial seed price to reflect opportunity cost.

3.6 BASIS OF COMPARISON

The basis used for comparing production factors and yields of the alternative farms with conventional farms is described below.

Information on average yields for each crop district for 1986 and 1987 was obtained from Manitoba Agriculture (1987b). These yield data were based on actual farmer surveys and had been collected and compiled by Statistics Canada. The 1986 average crop district yields are based on the 1986 census data; 1987 average crop district yields are based on results of 1400 survey respondents across agro-Manitoba. Alternative producer yields were compared to the average yield of the crop district in which they reside. The population sampled by Statistics Canada was all farmers, which would include both conventional and alternative farmers. As the number of alternative farmers appeared to be quite small in proportion to the total number of farmers, the error resulting from using this type of data base should be minimal.

Budget estimates calculated by the Farm Management Section of Manitoba Agriculture were used to compare costs of production. These budgets are estimated yearly to provide producers with an evaluation of the production costs associated with various crops (Manitoba Dept. Agric. 1985; 1987a). Fertilizer and chemical inputs in the budget, as well as seeding rates, are based on general departmental recommendations (Manitoba Dept. Agric. 1987a) which are the same recommendations available to all farmers. Although input prices may vary somewhat, it is assumed that Manitoba Agriculture prices were based on market prices which prevailed at the time that the budget estimates were made, as was the case for the simulator prices. This appears reasonable on examination of the budget assumptions provided with the crop estimates. The gross return for a particular crop for each crop district represented by a case farm can be determined by the appropriate average yield and product price. The provincial crop production cost estimate can then be subtracted from this to give the expected net cash return per acre per crop.

In addition to cost estimates available from Manitoba Agriculture, budgets for the 1987 crop year for four of the major prairie crops (spring wheat, barley, canola and flax-seed) have been developed by the Production Analysis Division of Agriculture Canada (Baudry and Strain 1987). These budgets were based on what would be a representative grain and oilseed farm for each of Manitoba, Saskatchewan and Alberta. The budget accounts only for those variable and fixed costs directly associated with crop production. The main data source that Agriculture Canada used in developing Manitoba's enterprise budget was the Manitoba Crop Insurance Corporation's Research Survey of Producers Production Practices. These budgets provide another basis for comparing production costs and to also verify the production costs estimated by Manitoba Agriculture.

Chapter IV

RESULTS AND DISCUSSION

This chapter presents and discusses the results of the case farm interviews. The first part, 'General Considerations', includes a summary of the motivations of the various producers for farming in an alternative manner, as well as some of the problems they have encountered. The next part, 'Environmental Considerations' summarizes the producers' practices in regards to crop rotations, pest problems and their control measures, soil conservation measures, straw management and tillage operations, and attempts to relate them to their environmental implications. Producer's comments are integrated into the discussion to elucidate the reasons for their individual practices. The 'Economic Analysis' section discusses the economic performance of the alternative producers' crop production system and compares them to what might be expected under conventional production.

4.1 GENERAL CONSIDERATIONS

Of the 10 producers interviewed, results from all 10 were used for the 'Environmental Considerations' and seven of the 10 were chosen for the 'Economic Analysis'. The remaining three, although they met the criteria for case study selection, were excluded from the economic analysis for the following reasons. One was in the process of retiring and had reduced his operation to approximately 120 acres, about half of which was in alfalfa, clover or summerfallow. Because of the present small scale of his operation, his farm was not used in the economic analysis. However, due to the length of time he has been farming without pesticides or fertilizers, (27 years), data from his farm was used in the environmental section. Another producer was trying to reduce his chemical use on but 160 acres of the 2080 acres that he farmed. On this 160 acres he has replaced inorganic fertilizer with an organic fertilizer, but he has not found reducing chemicals to be successful. He has been using reduced chemicals in this manner for about eight years. Because of the small amount and the small proportion of his total land which is farmed alternatively, he was excluded from the economic analysis. The remaining producer's data was not included in the economic analysis due to the large extent to which chemicals are still used on his farm.

Of the seven farms that were used for the economic analysis, only 1987 data could be obtained for two of the producers (Producers 4 and 5).

Before continuing with results of the case farm interviews, a summary of discussions with Agriculture Representatives is presented. Of the 26 representatives who replied as to whether farmers were requesting information in regards to using less chemicals, 10 said that they were receiving no such requests. The remainder said that any such requests they were receiving were the result of the depressed economic farm conditions. Some farmers are attempting to cut costs by reducing their fertilizers while keeping pesticides at normal rates, while for others the opposite was true. Many farmers are interested in ways to get the best use out of the chemicals they do use. There is also some interest in chemical substitutes, such as in the use of green manures to decrease fertilizer requirements. One of the agricultural representatives expressed his conviction that all farmers would eliminate the 'artificial' ingredients if they could find ways to. These responses indicate that farmers may be interested and receptive to alternative techniques which would allow them to trim back their chemical requirements.

4.1.1 Motivations and Problems of Alternative Farming

The 10 alternative farmers were asked in an open-ended question to describe the main reason why they had decided to reduce or eliminate use of chemicals in their operations. Seven noted one of the main motivations as being concern over the health effects of using chemicals and/or concern for food quality; four of these seven cited concern for their own and their families' health as being the main reason. Other reasons given for having decided to use alternative methods were:

- pesticides destroy natural control of pests and/or do not provide sufficient control of pests,
- we are mining the soil by using chemicals,
- we have a responsibility to future generations to maintain the environment,
- economic reasons; for two producers, economics was the main motivator initially, while concern for potential damage by chemicals is something which has since risen in importance,
- there is less labour involved in farming without chemicals, and,
- religious beliefs.

One producer who farms the majority of his land conventionally feels an important question to ask is, "Is there a different way of farming coming?" He is open to different ideas and feels farmers in general are becoming conducive to alternative ideas. He also feels that the farmers in his area are becoming more cautious about chemicals and are asking more questions regarding the uncertainties involved in using chemicals.

Although this study involves but a small sample of alternative farmers, the motives given for farming alternatively are similar to those found by other researchers, which were discussed in the literature review. The alternative producers' motives illustrates a common thread which exists among the producers interviewed (ie. a desire to farm in an efficient manner while at the same time maintaining the integrity of the soil and the environment with production of high quality foods absent of health risks from pesticides and fertilizers). This was confirmed when the participants were asked to rate various reasons for reduced or no chemical use on their farms from very important to not important (Table 1). Concern for the effect of chemicals on personal and family health and safety received the greatest number of high ratings followed by the desire to produce chemical-free food, and then concern over soil degradation.

The farmers were split with regards to whether financial sacrifices had been made due to pursuing an alternative form of agriculture. Two producers commented that the losses they incurred were the result of their own experimentation. One of these two was closer in practice to a conventional farmer. He has been experimenting with organic products for weed control on the 160 acres he farms alternatively and has had reduced yields which he attributes to the experimentation. Another commented that he has put money into the ground and not gotten anything back out for the last three

TABLE 1

Manitoba Producers Rated Reasons for Practicing Alternative Agriculture, 1987 Case Study

Reason	Number of Producers for Each Rating of Reasons				
	VI	I	MI	NVI	NI
Decrease input costs	5	4	-	1	-
Concern for safety/health	9	1	-	-	-
Chemical residue free food	7	3	-	-	-
For specialized market	1	2	3	1	3
Soil degradation	6	2	2	-	-
Environmental quality	5	3	2	-	-
Religious beliefs	1	1	1	1	6

I = important; M = minor; N = not; V = very years. Unfortunately this has been the situation for most prairie farmers. In the USDA (1980) study, most organic farmers surveyed felt their farm income was similar or lower than conventional farmers' were, and that their level of indebtedness was lower.

All but three of the alternative producers felt there was a lack of information available to assist them in farming without chemicals. Lack of information was cited as a problem in several other studies (Robinson 1983; USDA 1980). A recognition of alternative agriculture as a valid means of farming was cited as a requirement before this would change. Also required would be a better network among the farmers themselves. One farmer was particularly concerned that there was such a lack of proven information. He was concerned that he was responsible for so much of his own experimentation. Most farmers received ample support from their family while neighbours were often 'curious'. Most expressed the opinion that government agencies concerned with agriculture should become more receptive to means of food production outside of the norm.

There was a 50:50 split in opinion with regards to whether more labour was required to farm the way they do. The CBNS studies discussed in the literature review found that labour requirements in organic production were 12 percent greater, per unit value of crop produced, than conventional production (Lockeretz et al. 1981).

Of the producers that were using some chemicals at present, all were hoping to make further reductions in the future. None were planning an increase in use.

The lack of information for alternative farmers has been noted here and in other studies (McMullen and Durance 1985, Robinson 1983, USDA 1980, Wernick and Lockeretz 1977). Producers in the present study were asked what type of research or technical information specifically would assist them. Below is a summary of their suggestions:

- research into different crop varieties (for example weed competitive varieties),
- natural pest control methods (for example allelopathy),
- effects of various crops and weeds on soil biology,
- manure composting,
- more emphasis on soil biology, including a better understanding by everyone on how chemicals as well as organic products affect the soil biota, and
- research into marketing aspects of organic food.

4.2 ENVIRONMENTAL CONSIDERATIONS

4.2.1 Crop Rotations

The crop rotation program of each producer is presented in Table 2. The length of the rotations varied from three to 10 years. The length of rotations of Prairie farmers in

TABLE 2

Crop Rotation Program of Manitoba Alternative Agriculture Producers, 1987 Case Study

Producer	Rotation	Rotation Length (Years)
1	Wheat - wheat - barley or oats/clover[1] - clover plowdown	4
2	Wheat - oats - barley - wheat - oats - barley - brome and alfalfa (for 3 yrs.)[2]	9-10
3	Wheat - flax - barley or oats/clover - clover plowdown	4
4	Fall rye - field peas - flax - wheat - barley - weed manure - summerfallow	7
5	4 years cereal - 4 years forage - 1 year summerfallow	8-9
6	Wheat - barley/clover - clover plowdown[3] - summerfallow[4] - wheat/alfalfa - 2 yrs. alfalfa[2]	6-7
7	Cereal grain - legume - cereal - cruciferous crop	4
8	Wheat or barley - wheat or barley - pulse or row crop	3
9	Cereal crop - nurse crop with clover - clover plowdown	3
10	Cereal - peas - flax or canola	3

[1]Where /clover occurs, the crop is underseeded with clover.
[2]It was assumed the alfalfa was turned under and cultivated for part of the final summer of the rotation.
[3]The clover is for plowdown, seed or hay depending upon weather conditions and the need for hay.
[4]It was assumed that the field is summerfallowed only if clover seeded the previous year was used for seed or hay.

a survey by McMullen and Durance (1985) varied from three to seven years. Most producers commented that their program was flexible as dictated by economics and/or growing and weed conditions. Producer 2 said that he planned his program according to soil and weed needs, utilizing brome and alfalfa when the soil required fibre. He also commented that if the crop blew out one year he would put in rye the next to add straw. Producer 1 found that pulse crops were not competitive enough with weeds and therefore grew only cereals. All but one had a legume incorporated into their program.

Summerfallowing was regularly practiced by producers 4, 5 and 6. These producers also had longer rotation programs compared to most of the other producers, such that their fields are not frequently subject to summerfallow. For example, Producer 5's fields are summerfallowed only every eight to nine years. Producer 3 has regularly summerfallowed his fields approximately every four years but is currently reverting to plowdowns rather than a full year of summerfallow. Producers 1, 2, 6 and 9 also utilize a plowdown. In the cases of Producers 1, 3, 6 and 9 clover plowdowns are used, wherein clover is underseeded one year with a nurse crop, the nurse crop is harvested that fall and the clover, being a biennial, is left overwinter. The following year the clover is allowed to grow until June or July, at which point it is worked under and the field is treated as a summerfallow from that point. In terms of Producer 2's plowdown, in the last year of his rotation program, with alfalfa on the field, only one cut of alfalfa is taken (as opposed to the normal two) and then the alfalfa is turned under and treated as a summerfallow. Producer 7 stated that he only summerfallows when forced to as in a crop failure; Producer 8 only when necessitated by weed pressure. Producer 4 utilizes a weed manure, allowing weeds to grow one full summer, instead of planting a crop. He felt that weeds add essential elements to the soil.

All three producers that utilized forages either have livestock or had just recently given them up. Producer 1 has livestock but keeps his pastures separate from his crop production. This person has a definite rotation worked out which he has found to work well for him. Manure from his livestock is used on one fifty acre field only. He does not want to contaminate his other fields with weed seeds from the manure. Use of well-rotted manure will apparently diminish this problem, as many of the seeds then lose their viability (Woods et al. 1951). The manured field in fact received twice as many cultivations in 1986 as his other cropped fields (four and two operations respectively, with the heavy duty cultivator). The producer felt this was necessitated by the greater weed pressure on the manured field.

4.2.2 Pest Problems

The main pest problem encountered by alternative agriculture producers was weeds, and in most cases several weed species were involved. Two farmers considered wild mustard, two considered thistle and two considered wild oats, as their number one weed problem. One producer felt quackgrass was his biggest problem while another had quackgrass and millet. Millet and ladysthumb were cited as perennially being the problem for another of the farms. Other problem weeds were buckwheat, wild foxtail, stinkweed and storksbill. One farmer had leafy spurge moving into his pasture. In Robinson's (1983) study, the four most common weed problems among ecological-organic farmers were wild oats, wild mustard, wild millet and Canada thistle.

A number of control treatments were employed. Delayed seeding was used by several, whereby seeds of annual weeds are allowed to germinate in the spring before crops are sown. These weeds are then destroyed in the seeding process. Fall tillage, to encourage fall germination of annual weeds, which are then killed by winter frost, was also mentioned by several farmers. Shallow seeding and/or shallow cultivation was also utilized by several producers. Studies have shown that annual weed seeds at depths of 2 centimetres or less will rapidly lose viability, whereas those buried deeper will remain in dormancy and may be brought back up to the germination zone when tilling deeper (Foster 1984).

Competitive crops were also an important component of the weed control process for a number of producers. For example, oats were used by one producer when thistle became a problem, his reasoning being that oats mature early and compete with the thistle. Another producer felt that fall rye planted in the fall of a summerfallow year, gave good control the following summer, of weeds not destroyed by the summerfallow. Rye, barley, sweet clover, buckwheat, canola and millet are all considered effective smother crops (Man. Dept. Agric. 1986b). Summerfallowing was used by several as a means of control. When wild oats became a problem on parts of one producer's fields, he would cut them for green feed for his cattle.

A number of the producers used some herbicides for weed control. Most of these producers were trying to eliminate herbicides from their operation. For one however, small amounts of herbicides, used for spot spraying on problem areas of his fields, were a regular feature of his control regime and he wasn't planning any changes. Another producer felt that his wild oats problem could be controlled with the lower rates of chemicals that he was using at present, although he was planning to eventually eliminate chemical use.

Only two mentioned insects or disease as ever being a problem. One of these is situated in an area periodically plagued by grasshoppers; aphids were also a problem on his farm at times. His comment on these was that he tried to live with the problem. Another producer had a problem with smut in the past, which he attributed to barley sown on barley. Smut is no longer a problem, which the producer felt was due to his rotation program and use of certified seed. In the McMullen and Durance (1985) study, 75 percent of the Prairie farmers surveyed, indicated insects were not a problem; all indicated no controls were used for fungi.

4.2.3 Soil Conservation

All producers were aware of soil degradation problems in Manitoba. In most cases wind erosion was considered to be the greatest problem in their respective areas, although three commented on both wind and water erosion problems, and one considered water runoff to be the major area for improvement.

Table 3 presents a summary of the soil erosion measures cited by each producer plus a summary of field operations practiced on their fields in crop, as well as those fields occupied by a plowdown or summerfallow. As mentioned previously, four of the producers incorporate clover into their rotation program. When treated as a green manure clover contributes to organic matter due to it's large amount of vegetative growth and, because it is a legume, supplies nitrogen (Bailey 1987). It also provides ground cover from the year it is sown to the following summmer when it is

TABLE 3

Tillage Operations and Soil Erosion Measures Used by
Manitoba Alternative Agriculture Producers, 1987 Case Study

Producer	Soil Erosion Protection Measures	Tillage Operations on Cropped Land	Tillage Operations on Summerfallow(SF) or Plowdown(PD)
1	Trashcover; spreads manure; clover plowdowns	Fall - deep-till (1)[1] Spring - deep-till (1) - harrow(1)	PD - tandem disk (4)[1] - rodweed (2-3)
2	Work in straw; weeds allowed in low production land to add fibre; rye to add fibre to drifting soils (alfalfa)[2]	Fall - tandem disc (1) - deep till (1) Spring - cultivator (1)	
3	Avoids plowing; spreads straw (clover plowdowns)	Fall - deep-till (1) Spring - cultivator (1) - harrow (2)	SF - variable
4	Fall rye sown onto summerfallow; barley stubble maintained through winter; weed manure maintained through winter	Fall - oneway disc (1) Spring - harrow (2)	SF - plow (1) - deep-till (3) - oneway disc (4)
5	Alfalfa	Fall - cultivator (1) Spring - cultivator (1) - harrow (2)	SF - deep-till (1) - tandem disk (1) - cultivator (2-3)
6	Strawstrips every 60 feet; tree planting; no draining (clover plowdowns; alfalfa)	Fall - deep-till (1) Spring - cultivator (1) - harrow (1)	SF - deep-till (2) - tandem disk (0-1) - cultivator (1-2) - rod-weeder (1-2)
7	Reducing tillage operations (legumes)	Fall - deep-till (1) - harrow (2) Spring - harrow (2)	
8	Shelterbelts; angle cultivation	Fall - deep-till (1) Spring - cultivator (0-1) - harrow (1-2)	
9	Crop rotations; (clover plowdown)	----	
10	Tries to leave stubble on top (legume)	----	

[1]Numbers in brackets ( ) are numbers of times each operation is performed per field.
[2]Practices in brackets ( ) were those not specifically mentioned by the producer as a soil erosion measure but were derived from their rotation program.

worked into the soil, so that the field is not left bare during the most erosion prone times of the year, the winter and spring. If the clover is harvested as seed or forage the majority of the nitrogen is removed, as discussed in Chapter 2. In addition, the long tap roots of clover do not provide the organic matter that the vegetative growth does, nor as much as the extensive root system of grasses does (Derick et al. 1930). Alfalfa is an important constituent of three of the producers' rotation program, particularly Producer 5 (see Table 2). Alfalfa, as a leguminous forage, provides nitrogen and ground cover to the soil, plus it has an extensive root system, which provides organic matter and contributes to soil stability. Only one producer did not make use of a legume of some sort in his rotation program. All but three producers made use of a forage or green manure within their rotation program; and of those three, two made use of a nitrogen supplying legume.

Producer 1 recognizes that there is a trade-off between trying to maintain crop residue for erosion control and providing weed control through cultivation, but he tries to strike a balance between the two. Producer 2 felt that by working crop residue back into the soil rather than removing or burning it he is contributing to soil fibre. Although Producer 3 generally avoids use of the plow, he will resort to it when quackgrass is a problem. Producer 4's erosion control is incorporated into his rotation program (see Table

2). After harvest in the barley year, stubble is maintained over winter, and weeds are allowed to grow the following spring, through the stubble, as part of the weed manure year. The weed manure is not tilled all summer until the next spring and subsequently summerfallowed that summmer. The weeds are mown during the summer of the weed manure, prior to seed production, to attempt to prevent excessive weed seed contamination of the field. Fall rye is sown on summerfallowed fields in fall to protect the field over winter. The fields then, are not left bare over winter for the green manure or summerfallow years. Producer 6 leaves strips of untilled straw on his fields and has noticed a difference in terms of decreased soil drifting.

The most common fall tillage operation of the alternative producers was to deep-till (heavy duty cultivate) once. According to Manitoba Agriculture (1986a), one pass with a heavy duty cultivator will bury 20-30 percent of the crop straw, as compared to the plow which buries 90 percent. One producer uses a one-way disk which buries 40-50 percent of crop residue; another does one pass with a tandem disk (burying 35-65 percent of the crop residue) and another pass with a deep-till burying, in total, approximately 63 percent of his residue. The alternative producers on average, however, appear to be leaving approximately 70-80 percent of their crop residue on the soil surface over winter.

In a survey of conventional tillage practices, Slevinsky (no date) determined that the most common tillage practices for wheat, in one part of the survey area (near Russell, Manitoba), were two fall heavy duty cultivations, or one heavy duty and one light duty cultivation and then one spring harrowing in both cases. Slevinsky defined these as minimum till systems (also known as reduced tillage) and concluded that they would provide sufficient erosion protection, providing straw was not baled and good yields achieved.

Alternative producers performed an average of one fall tillage and two to three spring tillage operations. Based on this and the above then, alternative producers appear to be practicing minimum tillage with the exception of perhaps the one producer. Additionally, while the farmers in Slevinsky's survey performed two fall operations and one spring operation the alternative producers performed on average only one fall operation and two to three spring operations, therefore leaving more surface residue over winter. These results are in agreement with Robinson (1983) who found that while ecological-organic farmers and conventional farmers performed basically the same number of tillage operations, the former group performed more of their operations in the spring. In the USDA (1980) study, most organic farmers used a chisel (heavy duty cultivator) or disk-type implement and performed one to three more cultivations than conventional farmers, for weed control.

Table 4 summarizes measures taken to prevent or reduce soil salinization. Producer 1 is situated in an area which has some problems with salinity. He felt he was fortunate that he had livestock, in that he could put such areas into grass. Producer 2 felt mustard was useful in removing saline salts. Producer 3 gave an account of small saline spots which in the past he tried opening up by plowing deeply. He found that the first year after plowing they produced quite well but the second year, production would drop back to what it was prior to plowing. He has since found spreading manure on such areas to be useful. The remaining producers felt there was no problem on their farm with salinity or that their rotations helped prevent it from becoming a problem. Perennial forages, such as alfalfa, are considered an effective means of dealing with salinization as the deep-roots pull moisture from great depths (Barclay 1987).

Most producers were less specific in terms of measures to conserve moisture (Table 5). Most felt there was not a lot which could be done. One commented that his practice of spreading manure maintained organic matter which in turn increases the retention of moisture in his soil. Other practices mentioned included means to trap snow as for example fall rye, stubble left on the soil surface, tree planting and placing hay bales on hills. Seeding earlier to make greater use of spring moisture was also mentioned.

TABLE 4

Measures to Combat or Prevent Soil Salinization as Practiced by Manitoba Alternative Agriculture Producers, 1987 Case Study

Producer	Considered a Problem	Measures Taken
1	Some spots	Plant to grass
2	Some spots	Incorporates sandy soil from ditches
3	Not much problem	Spread Manure
6	No	Clover and reduced tillage assists prevention
9	No	Clover and alfalfa prevents
4,5,7,8,10	No	Rotations

TABLE 5

Moisture Conservation Measures Taken by Alternative Agriculture Producers in Manitoba, 1987 Case Study

Producer	Measure Taken
1	Fall rye at times; seed into stubble at times
2	Spread manure; incorporate straw
3	Leaves some stubble on soil surface; tree planting
4	Sometimes seed earlier
5	Usually too much moisture
6	No measure taken
7	Not a problem
8	Shelterbelts; trash cover
9	Tree planting; bales on hill
10	No measure taken

Table 6 summarizes measures taken by each producer to prevent organic matter loss as well as the straw management practices used by each. Fifty percent of the producers made use of a green manure to preserve and enhance soil organic matter. Although none mentioned alfalfa as a means of preventing loss of organic matter, three did have alfalfa within their rotation (one of the three also used green manures). The benefits of alfalfa in conserving organic matter have already been discussed. One producer uses cattle manure regularly, but only on the same 50 acre field each year. Another uses small amounts of hog manure on small parts of his fields. Most worked their straw back in, only one burned his on a regular basis. This individual indicated that a heavy straw yield necessitated this at times. He felt that loss of organic matter from burning was not a problem on his farm due to a thick topsoil. Producer 10, the producer who farms most of his land conventionally, commented that he feels fertilizers such as anhydrous ammonia greatly contribute to loss of organic matter. He had used such fertilizers on his fields at one time, until he noticed the ground was becoming hard and lifeless. This was on top of the health problems it was causing and therefore he no longer uses it.

The various ways of dealing with compaction, to either prevent or alleviate it, were:

TABLE 6

Straw Management Practices and Measures to Prevent Organic Matter Loss, as Used by Alternative Producers, 1987 Case Study

Producer	Straw Management[1]	Organic Matter Measures
1	Usually worked back in	Green manures; rotates cows in pasture
2	Worked in	Crop rotations (alfalfa)[2]
3	Usually worked in, small amount baled	Only bales straw when he needs it for himself (green manures)
4	Worked in	Weed manure; contemplating use of legume for green manure
5	50% worked in 50% burned	Not considered a problem, deep layer of soil on his fields (alfalfa)
6	Worked in	Green manures and working in straw (alfalfa)
7	Worked in	Reducing tillage (legume)
8	Worked in	Working trash back into soil
9	---	Green manure
10	---	Quit use of anhydrous ammonia

[1]In questionnaire producers were asked if they burned, baled, or worked straw in.
[2]Measures in brackets ( ) were those not commented on by the producer as a means of conserving organic matter but were derived from his rotation program.

- plow the affected spots instead of deep-tilling,
- avoid seeding when the soil is too wet,
- use of deep-rooted alfalfa to loosen up the soil,
- work in clover or buckwheat, and
- a little more tillage than normal to break up organic matter and make it available.

All but one producer said they do not get their soils analyzed for fertility, and that one said that although he does normally he has not in the last few years. Five producers have had their soils analyzed in the past. Although one of these regularly had his soils analyzed until two years ago, he would even then make use of the technical results but not the target yields and recommended inputs. Another producer who used to take samples related how he sent soil to three different institutions, two of which were fertilizer companies. He received three different recommendations with the two highest coming from both the fertilizer companies. This unreliability of fertilizer recommendations is apparently a common problem, at least in the United States (Zahradnik 1983).

4.3 ECONOMIC ANALYSIS

4.3.1 Yield Data

As described at the beginning of this chapter, seven of the 10 case farms were used for the economic analysis. From the seven analyzed, the acreage involved in their rotation programs, totalled over all farms, was 3040 acres in 1986 and 3818 in 1987. Again, as already noted, only 1987 data was obtained for Producers 4 and 5. Table 7 gives the number and percentage of acres devoted to specific crops, as well as the number of producers growing each crop. In both years the cropland usages of most significance were, in decreasing order, wheat, barley, oats and then summmerfallow or plowdown, with flax, hay, peas, canola and lentils accounting for a small proportion of the total acreage. Yields of the various crops in comparison to averages in the producer's respective crop district, are presented in Table 8. The small proportion of acreage devoted to oilseeds and specialty crops is interesting considering the amount of production of such crops in the alternative producers' crop districts. The seven alternative farms reside in crop districts two, three, seven and eight. For flax for example, according to the yield estimates by Statistics Canada (Man. Dept. Agric. 1987) districts two and three appeared to be medium producers of this crop in 1986 (1.5 million bushels in each of these regions), and districts seven and eight were the highest producers of flax of all the districts, at 4.1 million and 6.0 million bushels, respectively.

The greatest success in relation to achieving yields at least as good as the districts' average yields, appears to be with wheat and oats. This is consistent with these being two of the most popular crops on the case farms for 1986 and

TABLE 7

Proportions of Acreage Assigned to Various Crops on
Alternative Farms in Manitoba, 1986 and 1987

	1986			1987		
Crop	Producers Growing[1]	Acres	% of Total	Producers Growing[2]	Acres	% of Total
Wheat	4	925	30.4	7	1551	40.6
Barley	4	634	20.9	4	690	18.1
Oats	3	575	18.9	3	610	16.0
Summerfallow[3]	4	484	15.9	5	556	14.6
Flax	2	167	5.5	1	25	0.6
Tame Hay	1	75	2.5	4	182	4.8
Peas	-	-	-	1	53	1.4
Canola	1	130	4.3	1	51	1.3
Lentil	1	50	1.6	1	114	3.0
Total		3040	100.0		3818	100.0

[1] 1986 - included total of 5 producers

[2] 1987 - included total of 7 producers

[3] Summerfallow - included summerfallow and green manures.

TABLE 8

1986 and 1987 Yields of Manitoba Alternative Producers and their Respective Crop District Average (bu/acre)

	1986			1987		
Producer Number & Crop	Alternative Producer Yield	District Average	Percent Difference[1]	Alternative Producer Yield	District Average	Percent Difference[1]
Wheat Yields						
1	34.9	34.7	0.6	31.0	26.5	17.0
2	-	-	-	40.0	32.0	25.0
3	47.3	35.2	34.4	31.8	30.1	5.6
4	-	-	-	23.0	31.2	-25.6
5	-	-	-	25.0	30.1	-16.9
6	40.0	35.2	13.6	30.0	30.1	- 0.3
7	38.0	35.2	8.0	20.0	30.1	-33.6
Mean	40.0	35.1	14.2	28.7	30.0	- 4.1
Barley Yields						
1	52.0	57.7	- 9.9	-	-	-
2	25.0	54.9	-54.5	25.0	53.9	-53.6
3	44.0	59.3	-24.1	50.0	51.2	- 2.3
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	50.0	59.3	-15.7	50.0	51.2	- 2.3
7	-	-	-	33.0	51.2	-35.5
Mean	43.0	57.8	-26.0	39.5	51.9	-23.4

[1] Percent difference of producer yields from average yield of producer's crop district

TABLE 8. Continued.

	1986			1987		
Producer Number & Crop	Alternative Producer Yield	District Average	Percent Difference	Alternative Producer Yield	District Average	Percent Difference
Oats Yields						
2	73.0	72.7	0.4	85.0	58.6	45.0
3	90.0	68.5	31.4	65.0	55.2	17.8
6	70.0	68.5	2.2	70.0	55.2	26.8
Mean	77.7	69.9	11.3	73.3	56.3	29.9
Flax Yields						
3	18.0	25.3	-28.8	16.0	19.1	-16.2
7	28.0	25.3	10.7	-	-	-
Mean	23.0	25.3	- 9.0	16.0	19.1	-16.2
Canola Yields						
7	17.0	28.0	-39.3	4.6	25.1	-81.7
Tame Hay (tons)						
2	2.40	2.46	- 2.4	3.00	2.79	7.5
4	-	-	-	1.01	1.75	-42.3
5	-	-	-	1.80	2.02	-10.9
6	-	-	-	.75	2.02	-62.9
Mean	2.40	2.46	- 2.4	1.64	2.14	-29.8

1987. There was a great deal of variability with respect to yields, both within and between years. In 1986, wheat yields for alternative farmers ranged from 0.6 to 34.4 percent greater than region averages. In 1987, however, the range was even greater; from 25 percent greater to 33.6 percent lower than region averages. Of the four farms where wheat was seeded both years, Producer 1 showed a large increase in the percentage difference from the crop region between the two years (from 0.6 percent greater in 1986 to 17 percent greater in 1987); although both producer average yield and district average yield dropped from 1986 to 1987. The other three experienced large decreases from their yield advantage over the region averages in 1986 to 1987, where, in fact, two experienced lower yields than the region average in 1987. Producers 4 and 5 for whom data was collected for 1987 only, experienced yields which were 26.5 percent and 16.9 percent lower than conventional yields.

In all cases, for both years, the alternative farm barley yields did not meet the averages of their respective crop district. In 1986 producers' yields were lower by 9.9 to 54.5 percent, with a similar range in 1987 of 2.3 to 53.6 percent lower. Two of the farms' barley yields in 1986 as well as two in 1987 were considerably lower then district averages. The consistently lower yields of barley and the fact that barley was second in acreage only after wheat for all farms totalled, warrants a closer look at this crop, as given below.

Producer 1 grew 50 acres of barley in 1986 only, and this was on the only field on his farm which receives applications of cattle manure. The barley then, would have to compete with the weeds, whose seeds are transmitted to the field through the manure. Despite this competition, yields were only 9.9 percent lower than district average (52 vs. 57.5 bushels per acre). For the remaining three producers who grew barley in 1986 (Producers 2, 3 and 6), it can be seen, by referring to their respective rotation program in Table 2, that barley was usually grown as at least a second crop after summerfallow or plowdown. As a result some of the nutrients which had been made available by the summerfallow or plowdown would have been depleted by the preceding crop or crops. This might partially explain the consistently lower barley yields for these three producers, from their district average. Producer 7 grew barley in 1987, with much lower yields than his district average. This producer is actually still in the transition period and his situation is discussed more fully, further in the study.

While oats yields, for alternative farmers, ranged between 73 to 90 bushels per acre in 1986, and 65 to 85 bushels in 1987, the percent difference from region averages was quite variable in both years, ranging from .4 to 31.4 percent greater in 1986, and from 17 to 45 percent greater in 1987.

The remaining crops which could be compared to crop district averages were flax, canola and tame hay. Only two producers grew flax in 1986 and one in 1987, with somewhat inconclusive results. Producer 3 had lower flax yields than district average for both 1986 and 1987. Producer 7 achieved 10.7 percent greater flax yields than his district average. Canola was grown by the same single producer (Producer 7) for both 1986 and 1987, with yields being considerably lower than district averages for both years (17 vs. 28 bu/acre in 1986 and 4.6 vs. 25.1 bu/acre in 1987). A late spring frost apparently affected the 1986 crop, contributing to the low yield in that year. This producer, Producer 7, has been cutting down on his chemicals and fertilizers for four years, but in 1987 he made a major reduction in that he completely eliminated use of chemical fertilizers and replaced them with an organic product which professes to release nutrients already in the soil, making them available to the crop. He continued to use pesticides at a reduced rate. His yields were low in 1987 for all his crops, relative to the crop district averages, lending support to the assertion that yields decline considerably at first, when chemicals and/or fertilizers are eliminated. This producer has managed his transition in two stages then; the first stage involved a slow reduction in chemicals, and the second stage, at which he was at in 1987, involved major reductions, in this case of chemical fertilizers.

Hay yields were lower than the district average on the one farm (by 2.4 percent) which had productive hay stands in 1986, and at three of the four which did in 1987. Producer 4 had two fields of hay in 1987 and an average hay yield of 1.01 ton/acre compared to the district average of 1.75 ton/ acre. Of these two fields, one was in it's fifth year and the other in it's third year of productive stand. The lower yields for this producer may have been partially due to the length of time in productive stand. The first year of a harvest for Producer 6's alfalfa field was 1987. The alfalfa, however, apparently suffered a lack of moisture, attributing to the low yield of .75 ton/acre compared to the district average of 2.02 ton/acre. The conventionally produced forage stand may also have benefitted from chemical and fertilizer treatment which could have accompanied the nurse crop that the forage was seeded with, enabling the forage to establish a better stand. The conventional forage stand might have also benefitted from subsequent fertilizer or pesticide treatments.

4.3.2 Costs and Return Data

The crop simulator computes costs of the various factors of production, total costs and gross and net returns. A total cost and return summary per field and also per acre per crop is then computed.

A summary of net cash returns of each crop for each producer as well as farm averages is presented in Table 9. Net cash returns are total cash costs subtracted from total gross returns. It does not take into consideration such fixed costs as investment in land and buildings and machinery depreciation. The farmers gross returns are a reflection of not only his yields but also what grades and prices he received. Product prices used to determine gross returns are regular market prices, regardless of whether the producer received a premium for organic produce.

In both 1986 and 1987 hay acquired the greatest average net cash returns among the producers for all crops ($63.62/acre in 1986 and $45.15/acre in 1987). This situation should be considered with caution as hay availability, and therefore prices, varies considerably from year to year such that average net cash returns could be the lowest for hay at another period in time. After hay, the crops with the greatest net cash returns in 1986 were wheat ($\bar{x}$ = $48.76) followed by oats ($\bar{x}$ = $31.32). In 1987 the greatest net return after hay was oats ($\bar{x}$ = $23.54) and then wheat ($\bar{x}$ = $19.58). These mean values are averages of each producer's net cash returns per crop per acre, and do not represent the net cash return of each crop totalled among all farms and averaged. The latter value would be weighted by the acreage each farm had devoted to a particular crop and

TABLE 9

Alternative Producers Net Cash Returns[1] for Each Crop and Farm Average for Crop Production ($/Acre), 1986 and 1987

Producer-Year	Red Spring Wheat	Barley	Oats	Tame Hay	Other	Summerfallow or Green Manure	Farm Average for Crop Production 1986	Farm Average for Crop Production 1987	86/87 Mean
1-86	62.11	3.06	-	-	-	-42.98	33.31	-	
1-87	37.66	-	-	-	-	-31.38	-	21.73	27.52
2-86	-	-28.22	14.47	63.62	-	-	0.74	-	
2-87	22.02	-36.90	26.07	94.88	-	-	-	3.73	2.24
3-86	67.56	- 0.86	55.37	-	(Flax 8.19)	-22.90	12.27	-	
3-87	28.73	- 0.80	16.12	-	(HY320 -14.63)[2] (Flax 24.49)	-15.63	-	4.62	8.44
4-87	18.06	-	-	17.53	-	-32.77	-	4.91	----
5-87	9.74	-	-	58.22	-	-22.61	-	24.15	----
6-86	48.82	20.61	24.13	-	-	-35.01[3] -22.69	14.43	-	
6-87	26.55	4.44	28.42	9.98	-	-38.34[4] -24.62	-	2.64	8.53
7-86	16.56	-	-	-	(Lentils 257.90) (Flax 59.40) (Canola -31.19)	-30.38	31.08	-	
7-87	- 5.70	-27.88	-	-	(Peas -20.68) (Lentils -48.27) (Canola -21.10)	-	-	-23.75	3.66
1986 Mean	48.76	- 1.35	31.32	63.62	-	-30.79	18.37	-	
1987 Mean	19.58	-15.28	23.54	45.15	-	-27.56	-	5.43	

[1] Net Cash Returns as returns to investment, depreciation, labor and management.
[2] HY320 - Prairie Spring Wheat.
[3] In 1986, costs for green manure was $35.01/acre; costs for summerfallow was $22.69/acre.
[4] In 1987, costs for green manure was $38.34/acre; costs for summerfallow was $24.62/acre.

the corresponding grades. Hay values represent the value of the baled hay still on the field. Costs per acre of summerfallow and green manures, showed a large variation from \$22.69 to \$42.98 in 1986, and from \$15.63 to \$38.34 in 1987. In both years, it cost Producer 6 more for his green manure then for the summerfallow (\$35.01/acre and \$38.34/acre for green manure and \$22.69/acre and \$24.62/acre for summerfallow for 1986 and 1987, respectively). As his tillage operations were the same for working the green manure and the summerfallow, the difference reflects the seed and seeding costs.

Net cash returns per acre expressed as a farm average varied from \$0.74 to \$33.31 per acre in 1986 and from a loss of \$23.75 to a profit of \$24.15 per acre in 1987. There was a great deal of variability between producers for each year. Of the five producers for which data was obtained for both 1986 and 1987, all but one experienced a drop in net cash returns from 1986 to 1987. This would be a reflection in part, of the general drop in yields between the two years and in large part the drop in product prices from 1986 to 1987.

An average of the two years is presented in Table 9 for the five producers for whom data was collected for both 1986 and 1987. Producer 1's net cash return, averaged between the two years, was the highest at, \$27.52/acre, and was approximately 12 times higher than the lowest, which was

Producer 2 whose net cash return averaged between the two years was $2.24/acre). Producer 1's net cash return average was also approximately three times higher than the next highest average, which was Producer 6 at $8.53/acre. Producer 1 uses no pesticides or fertilizers, plus he has worked out a rotation program which he finds suitable to his conditions and which he adheres to. Producer 2 had the lowest return in 1986 and the second lowest return in 1987 ($0.74/acre in 1986 and $3.73/acre in 1987), although he has been practicing his system of of using very little chemicals or synthetic fertilizer, for 19 years. This producer, however, had a large proportion of his land in barley both years, which not only had poor yields, but also commanded a poor market price. Although Producer 3 has been reducing his use of chemicals and fertilizers for four years, he is still reliant on both chemicals and fertilizers, and considers himself to be still working his way through the transition period. His net cash returns as a farm average were $12.27/acre in 1986, and $4.62/acre in 1987. This producer has a considerable problem with weed control; a problem he says he inherited with the farm.

Producer 4 (whose net cash return as a farm average was $4.91 in 1987), has been farming without chemicals for 16 years. At present he is implementing a new rotation program on his farm and feels that, that land which is within the rotation program yields much better than that which has not been incorporated into the program. Although Producer 5's net cash returns were the highest of the producers in 1987 (net cash return as a farm average of $24.15/acre) a large portion of this was from hay ($58.22/acre); the return from his one other crop, wheat, was much lower at $9.74/acre. Producer 6 experienced a large decrease in net cash returns from 1986 to 1987, largely due to product price decreases. Producer 7's large reduction in the farm average net cash return of $31.08/acre in 1986 to a loss of $23.75/acre in 1987, reflects the previous comments regarding this producer. His results support the claim that yields and thus returns suffer in the first years of transition, or in this case that stage of his transition where he has made major reductions of chemical fertilizer.

4.3.3 Return Comparisons

Production cost estimates for a number of crops are prepared by Manitoba Agriculture yearly.[8] Inputs are based on Manitoba Agriculture Departmental recommendations which as previously mentioned are the same recommendations available to all farmers. The gross return for a particular crop for each crop district represented by a case farm could be determined by multiplying crop price by the appropriate average yield. As mentioned previously, crop district aver-

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[8] Manitoba Agriculture, Farm Management. Information Update. Farm Planning Guide. The two used here were: 1986 Crop Estimates, Dec. 1985; and, 1987 Crop Estimates, Jan. 1987a.

age yields were based on Statistics Canada survey results of actual farmers. The provincial production costs estimate was then subtracted from this to give the expected net cash return per acre per crop. This was considered an acceptable representation of 'conventional' crop production and therefore was used as a basis to compare to net cash returns of alternative farms. Three crops were compared; wheat, barley and flax. Although oats accounted for a large proportion of the alternative producers' cropped land, and hay a smaller proportion, the budget estimates prepared by Manitoba Agriculture do not include these two crops. Crop prices used to determine gross returns were those used in the simulator and were based on the following prices ($/bushel):

	1986	1987
No. 1 Red Spring Wheat	$3.18	$2.64
No. 1 Feed Barley	1.42	0.99
No. 1 Flax	4.39	4.40

A summary of net cash returns for alternative producers compared to the average of their crop district is given in Table 10. Wheat net cash returns were greater over conventional production data on three of the four alternative farms in 1986 and six of the seven alternative farms in 1987. On average, cash returns for case farms were $18.93/acre greater in 1986 (1.6 times greater) and $13.34/acre greater in 1987 (3.1 times greater).

TABLE 10

Net Cash Returns of Manitoba Alternative Producers Compared to District Averages ($/acre/crop), 1986 and 1987

	Wheat			Barley			Flax		
1986									
	Producer	District	Difference	Producer	District	Difference	Producer	District	Difference
1	62.11	28.64	33.47	3.06	4.33	- 1.27	-	-	-
2		-	-	-28.22	0.36	-28.58	-	-	-
3	67.56	30.23	37.33	- 0.86	6.61	- 7.47	8.19	37.49	-29.30
6	48.82	30.23	18.59	20.61	6.61	14.00	-	-	-
7	16.56	30.23	-13.67	-	-	-	59.40	37.49	21.90
x̄=	48.76	29.83	18.93	- 1.35	4.48	- 5.83	33.79	37.49	- 3.70
1987									
	Producer	District	Difference	Producer	District	Difference	Producer	District	Difference
1	37.66	-3.04	40.70	-	-	-	-	-	-
2	22.02	11.48	10.54	-36.90	-16.59	-20.31	-	-	-
3	28.73	6.46	22.27	- 0.80	-19.26	18.46	24.49	24.79	- 0.30
4	18.06	9.37	8.69	-	-	-	-	-	-
5	9.74	6.46	3.28	-	-	-	-	-	-
6	26.55	6.46	20.09	4.44	-19.26	23.70	-	-	-
7	- 5.70	6.46	-12.16	-27.88	-19.26	- 8.62	-	-	-
x̄=	19.58	6.24	13.34	-15.28	-18.59	3.31	24.79	24.49	- 0.30

The net cash returns averaged for barley were $5.83/acre lower on alternative farms in 1986 from conventional farm data (returns of $4.48/acre for conventional farm data and -$1.35/acre for alternative farm data). In 1987, all the representative conventional farm data experienced a loss with barley, as did three of the four alternative farms. With respect to the average net cash return for barley, the representative conventional farm average related to a loss of $3.31/acre more than the alternative farm average in 1987. Whereas all alternative producers had lower yields of barley than their crop district's average in both years, one of four alternative producers obtained better net cash returns than district averages for this crop in 1986 ($20.61/acre vs. $6.61/acre, respectively). For two of the four producers who grew barley in 1987, one had better net cash returns than his respective district average ($4.44/acre profit vs. $19.26/acre loss), and one did not experience as great a loss as his crop district average (losses of $0.80/acre vs. $19.26/acre).

Flax net cash returns are inconclusive due to the small proportion of the total acreage devoted to flax. One of the two producers who grew flax in 1986 and whose yields were considerably lower than district averages (18 bu./acre vs. 25.3 bu./acre) received $29.30/acre less than district averages. On the other hand the other producer, whose 1986 yields were only 2.27 bu./acre higher than district averages, had a net cash return $21.90/acre greater (58.4 percent greater) than the district average. Net cash returns for the producer who grew flax in 1987 were very similar to district averages although his yield was 16.2 percent lower.

4.3.4 Comparison to Agriculture Canada Data

The enterprise budgets developed by the Production Analysis Division of Agriculture Canada (Strain and Baudry 1987) provide another means of comparison for 1987 data. The cash income and variable cash costs for spring wheat, barley and flax as computed by the budget for Manitoba are presented in Table 11. Charges for crop insurance and interest on intermediate and long term loans have been excluded, since these cash cost factors were not charged to alternative producers. The remaining cash cost factors are similar to those charged to alternative producers. One difference is that Agriculture Canada did not include charges for miscellaneous overhead which was included in both the alternative producers budgets and the Manitoba Agriculture budgets. Again input price assumptions were based on market prices and appeared quite similar to those used for case farm analysis. Yield data used by Agriculture Canada had been derived from the Manitoba Crop Insurance Corporation (MCIC) Research Survey. Wheat and barley prices were based on No. 1 red spring wheat and No. 1 feed barley and were virtually the same as those used for the alternative farms. The flax price was lower,

TABLE 11

Agriculture Canada Enterprise Budgets for Three Crops in Manitoba, Crop Year 1987

	Wheat	Barley	Flax
Yield/bu	32.8	49.7	18.6
Price/bu.	$ 2.65	$ 1.00	$ 4.40
Gross Cash Income	$86.92	$49.70	$81.84
Cash Costs ($/Acre)			
Chemicals	$16.49	$16.49	$15.90
Fertilizers	27.67	27.67	10.80
Seed	5.75	4.88	7.48
Fuel & Lube	9.81	9.81	9.17
Repair & Maintenance (Machine)	6.97	6.97	6.31
Interest-Operating	.98	1.29	.77
Insurance-Machinery	3.56	3.56	3.45
Property taxes & Licence Fees	4.22	4.22	4.22
Total Cash Costs	75.45	74.89	58.10
Net Cash Return ($/acre)	11.47	-25.19	23.74

Source: Strain and Baudry 1987.

[1] Flax price of $4.40/acre was not the price used by Agriculture Canada but was that used for alternative producers as described in the text.

however, ($3.95/bu compared to the price used in the present study of $4.40/bu). The latter price was an average of what a farmer selling his flax September 30, 1987 would have received ($3.95) and what one selling January 15, 1988 would have received ($4.86). The price in the Agriculture Canada budget was adjusted to $4.40/bu. These budgets have not been applied to yield data of each crop district represented by an alternative case farm, as was done for Manitoba Agriculture budgets, to arrive at a net cash return per acre per crop for conventional crop production. Rather, the expected yield for wheat, barley and flax as presented by Agriculture Canada was used to arrive at the net projected returns of these crops for an average Manitoba farmer in 1987, which could then be compared to the net cash returns of alternative producers.

Net cash returns per acre for wheat were $11.47 per acre for the conventional data compared to the alternative farm average of $19.58 per acre for 1987 (range of -$5.70 to $37.66/acre); see Table 9. All but two of the alternative farms had greater net cash returns for wheat than the Agriculture Canada returns, even though only one of the alternative farms had greater yields (although three of the alternative farms had wheat yields very similar to the Agriculture Canada yield of 32.8 bu; see Table 9).

Agriculture Canada barley returns related to a loss of $25.19 per acre compared to the alternative farm average loss of $15.28 per acre in 1987 (range in alternative farms was -$36.90 to $4.44/acre). Two of the four alternative farms on which barley was grown in 1987, experienced greater losses than that projected by Agriculture Canada for conventional farms.

Agriculture Canada flax returns were $23.47 per acre, which were comparable to the flax returns of the one alternative producer's per acre return of $24.49 and his district's average of $24.79 per acre

4.3.5 Comparison of Cost Factors Between Alternative and Conventional Crop Production

Comparison of cost factors between alternative and conventional producers, gives an indication of what, if any, differences there are between the two in costs of production. The biggest difference in cost factors between the case farms and the Manitoba Agriculture and Agriculture Canada enterprise budgets were fertilizer and pesticide input costs. Table 12 outlines these costs, as well as machine investment and fuel costs for wheat for each of the three budget types for 1987; alternative farm data, Manitoba Agriculture data, and Agriculture Canada data. Farm average values are also given for each of these four costs, for each alternative producer.

Fertilizer and chemical costs were substantially higher in both the Manitoba Agriculture and Agriculture Canada

TABLE 12

Comparisons of Four Costs for 1987 Wheat Production ($/acre)
Alternative Producers, Manitoba Agriculture and Canada Agriculture Estimates

	Fertilizer	Pesticide	Fuel	Machine Investment
Manitoba Agric. Estimates	22.75	18.50	10.00	9.60
Canada Agric. Estimates	27.67	16.49	9.81	-
Producer 1	0.51 (0.39)[1]	0.00 (0.00)	8.78 (7.85)	6.69
Producer 2	11.68 (5.35)	0.44 (0.43)	4.13 (4.18)	10.46 -
Producer 3	4.94 (5.02)	9.03 (3.83)	6.19 (6.07)	10.29 -
Producer 4	0.00 (0.00)	0.00 (0.00)	7.42 (8.20)	10.24 -
Producer 5	0.00 (0.00)	(7.45) (3.22)	7.87 (6.04)	12.17 -
Producer 6	0.00 (0.00)	2.11 (.79)	7.36 (7.71)	7.87 -
Producer 7	18.03 (18.03)	2.74 (6.54)	7.67 (7.60)	7.34 -

[1] Figures in brackets ( ) are farm averages.

estimates. Of the alternative producers, only Producer 7's fertilizer costs approached the Manitoba Agriculture and Agriculture Canada estimates. His fertilizer costs of $18.03/acre were 80 percent as high as the Manitoba Agriculture estimate and 65 percent as high as the Agriculture Canada estimate. The fertilizer costs of this producer were for the organic product referred to in the previous yield data section.

Because alternative agriculture relies more on cultivation practices for weed control, fuel costs may be correspondingly greater, as found by Lockeretz and Wernick (1980b) in the CBNS studies discussed in Chapter 2. From the fuel costs per acre presented, this does not appear to be so for wheat. Fuel cost estimates by Manitoba Agriculture includes travel for farm business purposes whereas the case farm budgets includes fuel use strictly for crop production. Therefore there is some degree of uncertainty, but considering how much lower most of the case farm estimates are as compared to Manitoba Agricultural estimates, it is not likely that removal of this uncertainty would increase case farm estimates above Manitoba Agriculture estimates.

In general, machine investment estimates for the alternative farms are not significantly different from the Manitoba Agriculture estimate of $9.60 per acre. The two extremes, Producer 1 ($6.69/acre) and Producer 5 ($12.17/acre) are perhaps the exceptions. Producer 1 has a total machine investment of $4348.50 but this is spread over 650 acres. Producer 5 has a total machine investment of $2251.45, approximately half of that of Producer 1, but which is spread over 185 acres. Few differences were found in machine and implement sizes between organic farmers and conventional farmers in the CBNS studies (Lockeretz et al. 1981).

Machine investments did not change for the individual producers between 1986 and 1987 except for Producer 2 who had a very high machine investment of $32.56 per acre in 1986 and a correspondingly high fuel cost of $12.28 per acre. Some of his high cost equipment was sold between the two years which brought his investment costs and fuel costs down in 1987, but he also had to assume a custom charge of $3.12 per acre.

There are divergences in findings with regards to whether methods of alternative farming require higher labour inputs (see Roberts et al. 1979, Breimyer 1981, and Wagstaff 1987). The Agriculture Canada study assumes a Manitoba farmer allocates 1.5 hours of labour per acre to crop production. The crop simulator employed for alternative case farm analysis computes labour hours per acre, from hours of operation of equipment. As the extra labour purportedly required in alternative crop production is considered to be largely due to the extra cultivations required, this simulation gives an acceptable labour estimation. As seen from Table 13, labour

TABLE 13

Estimated Labour Hours/Acre of Manitoba Alternative Producers Based on Hours of Equipment Operation Required for Crop Production, 1986 and 1987

Alternative Producer	1986 Labour Hours	1987 Labour Hours
1	1.12	1.02
2	1.04	--
3	1.17	1.02
4	--	2.00
5	--	1.16
6	1.22	0.76
7	0.97	0.89
Mean	1.10	1.14
Agric. Canada Estimate		1.50

hours are not significantly different from those assumed by Agriculture Canada, with an average of 1.10 and 1.14 hours per acre in 1986 and 1987 respectively. This labour estimation was the farm average and included labour required for summerfallow operations. Producer 2 was excluded from the 1987 estimate because of his reliance on custom operations for that year, such that his labour estimate is not a true reflection of the labour required for crop production on his farm.

4.3.6 Premium Prices for Organic Produce

In the comparisons of net cash returns, all alternative producers' returns were based on the prices they would have received through regular market channels. Two of the producers, however, both of whom used no chemical or synthetic fertilizer, were able to sell their wheat as 'organic' wheat and were receiving prices above the Canadian Wheat Board price. Producer 1 received $2.10/bushel above the Wheat Board prices of $3.18/bushel in 1986 and $2.64/bushel in 1987 for No. 1 Red Spring Wheat, therefore receiving $5.28 and $4.74/bushel for wheat in each year respectively. Producer 4 received $5.00/bushel for No. 1 Red Spring Wheat in 1987. This produced substantial increases in the farm average net cash returns for these two producers. Producer 1's average net cash return increased in 1986 from $33.31/acre without the premium to $84.05/acre with premium; in 1987 the increase was from $21.73/acre without premium to $71.81/acre with premium. Producer 2's average net cash return increased in 1987 from $4.91/acre without premium to $33.45/acre with premium. This average net cash return represents the average for all acreage within the rotation, including summerfallowed or plowdown land.

The remaining producers in the economic analysis sold their produce through regular market channels. One of these producers had in the past shipped some of his organic produce to Ontario, but had incurred the shipping expenses himself, and felt that the final returns were not significantly different than if he had sold through regular market channels.

Both producers who received premium prices had found buyers located relatively close to their farms. These buyers were contacted and both indicated that at present, the organic market in Canada has not developed enough to support a large number of organic growers; the market could be saturated quickly. One of these buyers was shipping organic flour to England and he commented that there is a steadily increasing demand for organic food in Europe. Both stressed that growers interested in selling produce as organic food, should belong to an organic association. This way it is the association that has to verify and guarantee that the produce is certifiable as organic and the buyer won't have to deal with this himself.

Chapter V

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Alternative producers in this study were utilizing diverse crop rotations with legumes and forages (which included leguminous forages) integrated into the rotation. This is beneficial not only for weed control, but also in terms of producing a stable soil structure which is not overly susceptible to erosion agents such as wind and water. Although many of the farmers had some of their fields bare, either all summer as sumerfallow or part of the summer as plowdowns, a stable soil structure will enable the bare fields to withstand erosion agents better than fields with poor soil structure. As well, plowdown fields which are bare only part of the summer, do in fact have protective ground cover during the winter and spring, prior to being turned under.

The alternative producers do not appear to be over-cultivating and in fact appear to be avoiding such practices as excessive fall tillage and use of plows which bury a large proportion of the crop residue. They are also leaving an average of 70-80 percent of their crop residue on the surface overwinter. The alternative producers' tillage practices in fact, fall within the realm of 'minimum tillage' as defined in one Manitoba Agriculture study. Use of cultivation by these producers for pest control is geared, not so much towards the amount of cultivations as the timeliness of the operation.

Based on the information acquired through the case studies it is difficult to draw conclusions regarding how alternative agriculture will diminish the effects of agricultural pesticides and fertilizers on the Manitoba environment, including the human environment. The numbers of alternative farmers in Manitoba at present are too small to significantly decrease the amounts of pesticides and fertilizers used. What could be said is that the motivation the producers gave for adopting alternative agriculture was, concern over the health effects of using chemicals, particularly on family and personal health. The various reasons given by producers for deciding to farm by alternative methods indicated a strong desire to farm harmoniously with the environment, maintaining the soil and whole environment for future generations.

5.1.1 Overall Comparison

Oilseeds and specialty crops were not major components of the crops grown by alternative producers in 1986 and 1987. Wheat, barley and oats together accounted for 70.2 percent and 74.7 percent of the total acreage of producers in 1986 and 1987, respectively. Oilseeds and specialty crops accounted for only 11.4 percent and 5.9 percent of the total acreage in 1986 and 1987, respectively. The small proportion of the latter two crop types, together with the small overall sample size of alternative farms used in the study, prevents any conclusions of the economic success of oilseeds and specialty crops based on net cash returns. The smaller proportions that the alternative farmers devoted to each of these crop types, indicates that the farmers themselves feel they have more success with the cereals. Oilseeds and specialty crops may have more stringent fertility requirements and/or may be more susceptible to weed and insect infestations. This then may cause some restrictions as to the diversity of crops which may grown by alternative producers. Again, however, the small sample size prevents any such conclusions.

It is difficult to generalize how alternative farmers are doing in comparison to conventional farmers due to the large variability of yields obtained among the alternative farmers themselves. Additionally, it is difficult to distinguish how much of this variability in yields and returns is due to management practices, or differences in productivity between geographic regions, or variations in localized growing conditions for the two study years. This in turn exemplifies the limitations of only a two year study. It did appear, however, that at least for wheat, the alternative producers had a greater net cash return than their average conventional counterparts for 1986 and 1987. Barley on the other hand did not appear to be cost effective for the alternative or conventional farmers, although when prices dropped the extent they did between 1986 and 1987, alternative producers did not suffer losses to the same extent as a conventional farmer might, due to their lower input costs. As three out of three producers in 1986 and two of three producers in 1987 had greater oats yields than the district average, the returns for oats would appear to be greater. However no cost estimates were available to compare the magnitude of the difference.

Producers who have secured a premium price for their organic produce have increased their net cash returns substantially. Considering the low prices that most farmers are receiving at present, a premium of approximately $2.00/bushel above the Wheat Board price, would almost double their returns. Premium prices, however, are not an option available to most alternative producers at present, partially due to their locality but largely due to lack of demand. It would not be a wise decision for someone to decide to adopt organic farming practices solely to capture a premium price. And in fact, none of the producers in this study cited this as a main motivation for adopting alternative agriculture.

5.1.2 Limitations of the Study

It may be argued that conventional crop production in this study should have been represented by actual matched conventional farms. There is some merit to this as actual conventional farm data could also have been analyzed with the 'Crop Production Simulator', ensuring a uniform comparison between alternative and conventional crop production data, plus overall crop production returns could have been compared.

Time and budgeting constraints would have necessitated involvement of fewer alternative farms if a matched comparison had been made. As this is a preliminary study into the environmental and financial success of alternative crop production in Manitoba, it was decided that it would be preferable to initially examine the status and nature of a number of alternative farms. Also, there are inherent difficulties in trying to pair alternative farms with conventional farms, such as, for example, in matching farm size and soil type, creating error if farms were not properly matched.

A further limitation is that this study involved collection of data for only two years, 1986 and 1987. A longer term study would average out some of the wide fluctuations in yield and returns which were the result of environmental or economic conditions. It would indicate whether variable yields are a factor to be expected with alternative agriculture. On the other hand, long term study (for example five years or more) could also indicate whether more, or less, yearly variability in yields and returns might be expected in alternative crop production over conventional production. While conventional agriculture uses fertilizers and pesticides to help control fertility and pest problems, there is also a greater need for optimal environmental and economic conditions to obtain the maximum benefit from crop inputs.

Time and resource constraints made it difficult to fully assess both the economic productivity and the environmental considerations of alternative crop production. An initial appraisal of each was acquired, however, indicating the potential for further study in both these areas.

5.2 RECOMMENDATIONS

A number of recommendations are suggested as a result of this study.

1. Additional research should be performed on the following:

   i) Studies comparing the long-term effects of alternative and conventional farming on soil properties should be performed on paired farms, to assist in determining the difference in soil properties, if any, which might be expected over time when farming alternatively. This would require examination of soils farmed in their specific manner for various periods of time (for example 5, 10, 15 or 20 years), to determine the time factor required for changes to occur. It would involve collection of actual field data throughout various times of the year. Soil properties to investigate would be for example, organic matter content, examination of the soil profile, moisture content, and rate of erosion. There would be a challenge in matching the alternative and conventional farms, as the soil properties which existed prior to the beginning of each treatment would be unknown. Such studies could assist in determining which practices are particularly useful in preserving soil integrity and which practices should be modified and how. Soil erosion studies on summerfallowed land on both conventional and alternative farms could indicate what effect the farmers' use, or lack of use, of a rotation program and/or legumes has on erosion of summerfallowed land.

ii) Studies such as the present study performed over a longer time-span are required to indicate the profitability of alternative agriculture over the long-term. A minimum suggestion would be five years, which may average out some of the fluctuations in yields and returns due to environmental and economic conditions, as discussed in the limitations section

iii) Comparisons to actual conventional farms would enable a comparison of net cash returns between alternative and conventional agriculture, for the entire crop production enterprise. This would take into account the costs of summerfallowing and plowdowns and any differences in labour requirements which may occur between the two.

iv) It is suggested that one or more producers be followed through the transition from conventional to alternative crop production. The transition is apparently the most difficult period yet there is very little documented data indicating the degree to which yields and returns are depressed and for how long. Such data as well as a documentation of what practices were and were not successful would be invaluable to researchers and farmers alike. Following one or more established alternative producers, of similar geographic characteristics, through the same time frame would provide a valuable basis of comparison between the two stages.

v) This study was performed at a time when agriculture product prices were very depressed. The long-term approaches mentioned above should be carried into a period when market prices of crops have risen from their present depressed positions to observe how alternative agriculture fares under more 'normal' conditions.

vi) A whole farm analysis which included livestock and crop production enterprises would give an indication of returns to the entire farm enterprise, as well as to differences in land use between alternative and conventional producers.

vii) Wildlife studies performed on alternative farms could suggest how wildlife responds to this type of farming. There are indications that wildlife benefit from not only the reductions in chemicals, but also the increase in cover, habitat, and food supply (Youngberg et al. 1984) This could be compared to wildlife response to more conventional practices as well as to such practices as zero-tillage, which requires increased use of pesticides.

viii) Studies which focus on conventional agriculture's contribution to nonpoint pollution agents in Manitoba, such as fertilizers and pesticides, would give indications of the potential benefit of alternative agriculture as a means of reducing these pollutants.

2. A number of studies have been performed in the past by Agriculture Canada regarding the financial productivity of various crop rotation programs. These studies originated mainly before fertilizers and pesticides had acquired the place of importance in agriculture that they experience today. An updated version of such studies and pertinent technical bulletins would be of value to both alternative and conventional farmers. There was also considerable research originating from the same time period regarding nonchemical fertilization and pest control methods, which could also be updated and made available to farmers.

3. It is recommended that a resource person be assigned whose duties would include, for example, organizing meetings, speakers, newsletters and farm tours, with such funtions being available to alternative producers as well as any other interested farmers. At present alternative producers in Manitoba acquire a good deal of their information through their own experimentation or through other alternative producers. However, these producers are scattered throughout the province and therefore, it is difficult and costly for them to try to organize a network of communication. The functions performed by the resource person would not only assist alternative farmers in acquiring information from peers and experts, but

would also give conventional farmers an opportunity to acquire information on alternative methods of agriculture. Such functions would be of aid to conventional farmers in determining if alternative agriculture is an avenue they would like to pursue, or if there are perhaps some features of alternative agriculture which could be applied to their farms. This position could be funded by Manitoba Agriculture, Canada Agriculture, or ideally, could be jointly funded by an environmental agency, such as Environment Canada, and one of the above agricultural agencies.

4. It is recommended that governmental agencies work cooperatively with one or two producers within Manitoba to establish these producers' farms as demonstration farms. This would provide the mechanism to fulfill the preceding recommendations. Such demonstration farms could be of value to both farmers and researchers in that:

   i) Field days and tours could give alternative farmers an opportunity to get together with like-minded individuals to share ideas. It would also give conventional farmers an opportunity to obtain information which could assist them in decreasing their chemical usage.

ii) The demonstration farmer would receive valuable information and suggestions from his peers as well as from agriculture and environment experts (for example agronomists, economists and biologists) to facilitate agricultural production which is both environmentally and economically stable.

iii) Researchers would be provided with a constant source of information and could build a valuable data base in regards to short-term and long-term economic and environmental performance.

5. It is recommended that marketing opportunties for organic produce in Manitoba be examined. This would include determination of consumer interest in organic products and for what products, possible ways of introducing organic products into the market, as well as how to assure quality control (i.e., that the produce is actually organic). This recommendation would be best taken up by private industry. Marketing studies by government may be seen as an endorsement of organic produce as possessing superior nutritional quality, which may not necessarily be true.
6. It is strongly recommended that any further investigation involve direct participation with alternative producers. These producers are all concerned with

environmental quality and with the sustainability of agriculture. They are all:

- willing to cooperate with researchers,
- open to different techniques, and
- anxious to increase other people's exposure to alternative agriculture.

This is an opportunity which should not be passed up by government and university researchers to investigate new approaches to crop production.

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Appendix A

DEFINITION OF TERMS

Crop Rotation - "A cropping system that consists of a series of crops or cultural practices used in a specified sequence over a period of years" (Gorby 1959).

Green Manure - According to Bailey (1987) "A green manure crop is one that matures to a certain physiological stage of growth and then is cultivated into the soil. Theoretically, any crop which produces a significant quantity of vegetative growth can be used as a green manure . . . . (However) annual grain legumes (or pulses) and perennial forage legumes provide high protein, . . . that breaks down rapidly in the soil. Furthermore, they generally provide large quantities of vegetative growth. For these reasons, legumes are the most efficient and economical green manure crops."

Mixed Farm - is a farm which includes more than one type of enterprise, the most usual ones being crop production and livestock production enterprises.

Nonpoint Pollution - are pollutants which originate from more diffuse sources as opposed to the obvious sources of point pollution. The contributors of nonpoint pollution are for example sediments, nutrients, pathogenic bacteria, pesticides, acid rain and polychlorinated biphenyls (Chesters and Schierow 1985).

Plowdown - is another term for a green manure. Crops or weeds to be used as a plowdown are usually allowed to grow into the summer, until about June or July and are then tilled under. A clover plowdown for example is usually planted one year with a nurse crop; the nurse crop is harvested in the fall of that year, but the field is not tilled, to allow the clover to overwinter. The clover grows the spring of the second year, is worked under at some time in the early summer, and the field is treated as a summerfallow for the remainder of the summer. The field receives some protection from erosion during the fall and winter that the plowdown overwinters, and the following spring. Once it is worked under though, it is subject to the same erosive agents as a summerfallow.

Summerfallow - no crop is sown in a summerfallow year and the field is periodically tilled through the summer. According to Hopkins and Barnes (1928) "(t)he main advantages of the summerfallow are to control weeds, to conserve moisture and to facilitate earlier seeding in the spring. The disadvantages of the summerfallow consist in that there is no revenue from the land for one entire year and, in districts liable to soil drifting, the summerfallow is more liable to blow". Erosion from water runoff may also be a problem.

Transitional Farmer - is a farmer converting from his former conventional system to some form of alternative farming. The farmer may decide to make the changes immediately or gradually over a period of years. This transition phase is apparently characterized by weed problems and low yields.

It is difficult to distinguish the beginning of the transition period if the farmer is slowly phasing out fertilizers and pesticides. It is often even more difficult to determine the end of the transition period. Farming in itself is a constant learning process, farming without chemicals is even more so. Some farmers who have been farming alternatively for a number of years still consider themselves in the transition stage.

Trash Cover - straw residue from a crop harvest, which is left at the soil surface. The amount of trash cover may vary from 0 - 100 percent.

Weed Manure - weeds which are allowed to grow as a green manure.

Appendix B

PRODUCER QUESTIONNAIRE

PRODUCER QUESTIONNAIRE

Name:

Date of Interview:

Municipality containing majority of land:

The below questions refer only to that land on which you use reduced or no chemical input and which is not permanent pasture.

A. CROP PRODUCTION

1. Crop year:

2. Indicate machinery owned, year manufactured, year purchased and value at beginning of year (see attached sheets).

3. Indicate machinery rented or custom operations and charges (see attached sheets).

4. What is the pattern of your crop rotation program?

5. Total fertilizer costs (synthetic and natural)

6. Total pesticide costs (herbicides, insecticides, fungicides, etc.)

7. Total fuel costs (please estimate the cost for crop production only)

8. Do you recieve a premium price for any of your produce?_____ If yes please explain for what crop, price recieved and of what nature is the buyer (broker, bakery, health food store, public, etc.)

Crop	Price Recieved	Buyer

9. Crop practices:

	1	2	3
a) Crop			
b) Soil type (light, medium, heavy)			
c) Number of acres			
d) Yield			
e) Average grade and dockage			
f) Straw - worked back in, baled or burned (totally or in windrows)			
g) Fertilizer used and rates (including manure)			
h) Seed - foundation, certified, commercial or other/and seeding rate			
i) Chemicals used and rates			
j) Field practices - list all field operations from previous fall to harvest. Specify implement used (pulled by which tractor when applicable) and number of times each is used over the field. Include operations for breaking forage stand.			
For forage or silage:			
k) If fall grazing please describe herd makeup			
l) Please give rotation length in total number of years of productive stand obtained before breaking.			

Continue on provided sheets for additional crops if necessary.

10. Please describe any weed, insect or disease problems you have had on your fields - for each problem answer the following:
    a) How many years have you had this problem?
    b) What percentage of your fields was affected?
    c) How was it treated?
    d) How effective was the treatment?

    Weeds   Insects/Diseases

11. Please briefly describe any other farm related operations through which you derive income other than those already described.

12. Please estimate what percentage of your annual net income is from your crop production operations.

B. Soil Conservation

1. Are you aware of any soil erosion problems in Manitoba?

2. Do you feel there are any such problems in your area in general?

3. Do you take soil conservation measures on your farm and what are they, in regards to any of the following:

    a) soil erosion

    b) soil salinization

    c) drought

d) loss of organic matter

e) soil compaction

4. Do you have your soils analyzed for fertility? If yes, how often and how do you use the results?

C. Producer Attitudes

1. Please briefly describe why you decided to reduce or eliminate chemical usage from your operation.

2. Could you please check off the below reasons for either reduced or no-chemical use in your operation, by level of importance to you (VI=very important; I=important; MI=minorly important; NVI=not very important; NI=no importance);

	VI	I	MI	NVI	NI
a) to decrease input costs					
b) concern for effect of chemicals on personal/family safety and health					
c) to produce food which has little or no chemical residue					
d) to take advantage of a potential specialized food market					
e) concern over soil degradation					
f) desire to reduce chemical input into the environment					
g) for religious reasons					
h) other (please specify)					

3. Have you experienced any of the below problems due to farming with reduced/no chemicals (include any comments you may have on each):

   a) financial sacrifices have been made

   b) lack of readily available information

   c) lack of support from neighbours/friends/family

   d) lack of technical support from government

   e) difficulty obtaining assistance from financial institutions

   f) requires more labour

   g) landlord reluctance to allow it on their land

   h) other, please specify

4. Please indicate if you plan on making any of the below changes in your farming operation in the near future. If yes, please briefly explain the changes for each and your reasons for making such changes.

   a) further reduction in chemical use_____

   b) increase in chemical usage_____

   c) reduction in acres farmed_____

   d) expansion in acres farmed_____

e) change in crops_____

f) change in field operations (seeding/harvest/tillage)_____

g) other (please specify)_____

5. Have you any comments as to what type of research or technical information would assist you in farming with reduced/no chemicals?

D. PRODUCER PROFILE

The remaining questions refer to all the land you farm.

1. Acres of farmed land owned_________ rented_________

2. How many acres of your operation is:

   a) under cultivation____________

   b) permanent pasture____________

   c) other ____________

3. Years farmed ____________

4. Years farmed with reduced/no chemical system________

5. Total acres farmed with reduced/no chemicals________

6. If you have ever farmed conventionally, please describe your transition, including such things as length of time required and problems encountered.

7. Level of education - High school or less _____
   Community College _____
   University _____

8. Age <30____ 31-40____ 41-50____ 51-60____
>60____

9. Do you know of any other farmers who you feel are successful at this type of farming? Please give their name, phone number, location and type of farming operation.

E. Additional comments

Appendix C

SUMMARY SHEET

A COMPARATIVE ASSESSMENT OF ALTERNATIVE AND CONVENTIONAL AGRICULTURAL SYSTEMS IN MANITOBA

Problem Statement: Uncertainty over present 'conventional' methods of agriculture is leading many farmers to seek out more sustainable alternatives. These uncertainties may be the result of a combination of: increasing production costs; decreasing product returns; soil degradation; acute and chronic effects of agricultural chemicals on human, animal and environmental health; and an over-reliance on nonrenewable fossil fuels. Alternative agriculture, which uses little or no agricultural chemicals, is being adopted increasingly throughout North America. There is, however, a definite lack of current information available which enables Manitoba farmers to judge the viability of such systems for their operations.

Objectives: The objectives are to compare alternative systems to conventional systems in terms of, (1) the environmental implications for soil and water conservation potential and decreased chemical usage, and (2) the net returns achieved for crop production.

Methods: The methods will include, (1) a literature search to provide background information and examine existing data on alternative systems, (2) personal communications with various members of government, the agricultural industry and the academic community, and (3) interviews with selected samples of farmers practicing some form of alternative agriculture to obtain crop production, soil conservation and producer attitude information.

The criteria for producer selection will include: (1) he/she should have made a conscious decision to farm with significantly less or no chemicals, (2) he/she should have been practicing their own particular alternative system for approximately five years to ensure they have completed the transitional phase.

Thank-you for participating in this study which is part of the requirements for my masters degree in Natural Resource Management and which is being funded by the Environmental Protection Service of Environment Canada. A summary of the final results will be sent to participants. If you have any further comments please feel free to contact me.

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Appendix D

EXAMPLE OF CROP SIMULATOR OUTPUT

Farm Analysis System

Department of Agricultural Economics

University of Manitoba

Year 1987
RECORD # 187

Total $ Cost For Repairs	Total $ Cost For Fuel	Total $ Cost For Overhead	Total $ Cost For Labor	Total $ Cost For Machinery Insurance	Operating Capital Interest Rate
-1.00	5101.70	3627.00	-1.00	-1.00	8.50

Value Improved Land $/Acre	Value Unimproved Land $/Acre	Value Improved Pasture $/Acre	Value Irrigated Land $/Acre
557.00	0.0	0.0	0.0

Taxes Improved Land $/Acre	Taxes Unimproved Land $/Acre	Taxes Improved Pasture $/Acre	Taxes Irrigated Land $/Acre
4.43	0.0	0.0	0.0

NOTE: A -1.0 means our DEFAULT was used.

Farm Analysis System — YEAR 1987

Department of Agricultural Economics — RECORD # 187

University of Manitoba

LIST OF MACHINERY AND BUILDING INVENTORY

Inventory #	Tillage Name	Size	Year Manufactured	Year Purchased	Hours Used	Beginning of year Value	End of year Value	Depreciation	Investment	Depreciation Rate
1-O	TRACTOR(DIESEL)	100	1974	1974	349	15300	13770	1530	1308	0.100
2-O	CULT. H.D. WING	27	1975	1975	112	4500	4050	450	385	0.100
3-O	AUGER-MOTOR	6	1981	1981	63	900	810	90	77	0.100
4-O	ROD-WEEDER	36	1979	1981	8	2250	2025	225	192	0.100
5-O	PRESS DRILL	18	1979	1982	72	9000	8100	900	769	0.100
6-O	SWATHER(PTO)	21	1984	1986	52	3600	3240	360	308	0.100
7-O	COMBINE PTO	11	1974	1974	72	10800	9720	1080	923	0.100
8-O	TRUCK	170	1976	1983	213	4500	4050	450	385	0.100
9-R	TANDEM DISC-T	18	1	0	34	0	0	0	0	0.0
						50849	45764	5084	4347	

S - Sold(Month of Sale)
O - Owned
R - Rented

P - Purchase(Month of Purchase)
C - Custom
(number) - Month of Sale or Purchase

Machinery Cost Per Acre Summary

Crop Red Spring Wheat

Field # 1

Client # 187

Acres	150.
Average Field Size	150.
Distance Field to Storage	1.0
Distance Storage to Market	1.0
Yield/Acre	31.0
Improved Acreage	

Code #	Tillage Name	Size	# Times Over	Acres /Hour	Labor Hours	Variable Costs Fuel $/AC	Lub. $/AC	Repairs $/AC	Total Variable Cost $/AC	Fixed Costs Insur. $/AC	Invest. $/AC	Deprec. Cost	Total Fixed Cost	Total Cost
2	CULT. H.D. WING	27.	3.00	13.47	40.7	0.94	0.14	0.79	1.87	0.02	0.59	0.69	1.30	3.17
3	AUGER-MOTOR	6.	2.00	16.00	4.7	0.06	0.01	0.03	0.10	0.00	0.12	0.14	0.26	0.36
5	PRESS DRILL	18.	1.00	6.98	26.4	0.88	0.13	3.84	4.85	0.04	1.18	1.38	2.61	7.46
6	SWATHER(PTO)	21.	1.00	9.74	17.6	0.85	0.13	0.11	1.09	0.02	0.47	0.55	1.04	2.13
7	COMBINE PTO	12.	1.00	7.10	25.6	1.16	0.17	3.63	4.96	0.05	1.42	1.66	3.13	8.09
8	TRUCK	170.	1.00	2.35	67.0	2.31	0.35	3.00	5.66	0.02	0.59	0.69	1.30	6.96
1	TRACTOR(DIESEL)	100.						3.96	3.96	0.07	2.01	2.35	4.43	8.40
	TOTAL COST/ACRE/FIELD				182.0	8.14	1.22	16.98	26.33 ***	0.21	6.39	7.48	14.08 ***	40.42 ***

Machinery Cost Per Acre Summary

Crop Red Spring Wheat

Field # 2

Client # 187

Acres 150.
Average Field Size 150.
Distance Field to Storage 1.0
Distance Storage to Market 1.0
Yield/Acre 31.0
Improved Acreage

Code #	Tillage Name	Size	# Times Over	Acres /Hour	Labor Hours	Variable Costs: Fuel $/AC	Lub. $/AC	Repairs $/AC	Total Variable Cost $/AC	Fixed Costs: Insur. $/AC	Invest. $/AC	Deprec. Cost	Total Fixed Cost	Total Cost
2	CULT. H.D. WING	27.	3.00	13.47	40.7	0.94	0.14	0.79	1.87	0.02	0.59	0.69	1.30	3.17
3	AUGER-MOTOR	6.	2.00	16.00	4.7	0.06	0.01	0.03	0.10	0.00	0.12	0.14	0.26	0.36
5	PRESS DRILL	18.	1.00	6.98	26.4	0.88	0.13	3.84	4.85	0.04	1.18	1.38	2.61	7.46
6	SWATHER(PTO)	21.	1.00	9.74	17.6	0.85	0.13	0.11	1.09	0.02	0.47	0.55	1.04	2.13
7	COMBINE PTO	12.	1.00	7.10	25.6	1.16	0.17	3.63	4.96	0.05	1.42	1.66	3.13	8.09
8	TRUCK	170.	1.00	2.35	67.0	2.31	0.35	3.00	5.66	0.02	0.59	0.69	1.30	6.96
1	TRACTOR(DIESEL)	100.						3.96	3.96	0.07	2.01	2.35	4.43	8.40
	TOTAL COST/ACRE/FIELD				182.0	8.14	1.22	16.98	26.33 ***	0.21	6.39	7.48	14.08 ***	40.42 ***

Machinery Cost Per Acre Summary

Crop Red Spring Wheat

Field # 3

Client # 187

Acres	150.
Average Field Size	150.
Distance Field to Storage	1.0
Distance Storage to Market	1.0
Yield/Acre	31.0
Improved Acreage	

Code #	Tillage Name	Size	# Times Over	Acres /Hour	Labor Hours	Variable Costs Fuel $/AC	Lub. $/AC	Repairs $/AC	Total Variable Cost $/AC	Fixed Costs Insur. $/AC	Invest. $/AC	Deprec. Cost	Total Fixed Cost	Total Cost
2	CULT. H.D. WING	27.	1.00	13.47	13.6	0.94	0.14	0.79	1.87	0.02	0.59	0.69	1.30	3.17
3	AUGER-MOTOR	6.	2.00	16.00	4.7	0.06	0.01	0.03	0.10	0.00	0.12	0.14	0.26	0.36
5	PRESS DRILL	18.	1.00	6.98	26.4	0.88	0.13	3.84	4.85	0.04	1.18	1.38	2.61	7.46
6	SWATHER(PTO)	21.	1.00	9.74	17.6	0.85	0.13	0.11	1.09	0.02	0.47	0.55	1.04	2.13
7	COMBINE PTO	12.	1.00	7.10	25.6	1.16	0.17	3.63	4.96	0.05	1.42	1.66	3.13	8.09
8	TRUCK	170.	1.00	2.35	67.0	2.31	0.35	3.00	5.66	0.02	0.59	0.69	1.30	6.96
1	TRACTOR(DIESEL)	100.						3.00	3.00	0.07	2.01	2.35	4.43	7.43
	TOTAL COST/ACRE/FIELD				154.8	6.26	0.94	14.43	21.63 ***	0.21	6.39	7.48	14.08 ***	35.71 ***

Machinery Cost Per Acre Summary

Crop Red Spring Wheat

Field # 4

Client # 187

Acres	50.
Average Field Size	50.
Distance Field to Storage	1.0
Distance Storage to Market	1.0
Yield/Acre	31.0
Improved Acreage	

Code #	Tillage Name	Size	# Times Over	Acres /Hour	Labor Hours	Variable Costs Fuel $/AC	Lub. $/AC	Repairs $/AC	Total Variable Cost $/AC	Fixed Costs Insur. $/AC	Invest. $/AC	Deprec. Cost	Total Fixed Cost	Total Cost
2	CULT. H.D. WING	27.	3.00	12.48	14.7	1.01	0.15	0.85	2.02	0.02	0.59	0.69	1.30	3.32
3	AUGER-MOTOR	6.	2.00	16.00	1.6	0.06	0.01	0.03	0.10	0.00	0.12	0.14	0.26	0.36
5	PRESS DRILL	18.	1.00	6.98	8.8	0.88	0.13	3.84	4.85	0.04	1.18	1.38	2.61	7.46
6	SWATHER(PTO)	21.	1.00	9.34	6.1	0.88	0.13	0.12	1.13	0.02	0.47	0.55	1.04	2.18
7	COMBINE PTO	12.	1.00	5.54	10.9	1.49	0.22	4.65	6.36	0.05	1.42	1.66	3.13	9.49
8	TRUCK	170.	1.00	2.35	22.3	2.31	0.35	3.00	5.66	0.02	0.59	0.69	1.30	6.96
1	TRACTOR(DIESEL)	100.						4.37	4.37	0.07	2.01	2.35	4.43	8.80
	TOTAL COST/ACRE/FIELD				64.4	8.72	1.31	18.60	28.63 ***	0.21	6.39	7.48	14.08 ***	42.71 ***

Machinery Cost Per Acre Summary

Crop Sweet Clover Se | Field # 5

Client # 187

Acres 150.
Average Field Size 150.
Distance Field to Storage 1.0
Distance Storage to Market 1.0
Yield/Acre 0.0
Improved Acreage

Code #	Tillage Name	Size	# Times Over	Acres /Hour	Labor Hours	Fuel $/AC	Lub. $/AC	Repairs $/AC	Total Variable Cost $/AC	Insur. $/AC	Invest. $/AC	Deprec. Cost	Total Fixed Cost	Total Cost
					Variable Costs					Fixed Costs				
2	CULT. H.D. WING	27.	2.00	13.47	27.2	0.94	0.14	0.79	1.87	0.02	0.59	0.69	1.30	3.17
4	ROD-WEEDER	36.	1.00	19.86	8.8	0.39	0.06	0.08	0.52	0.01	0.30	0.35	0.65	1.18
9	TANDEM DISC-T	18.	2.00	8.81	40.5	0.94	0.14	0.0	7.08	0.0	0.0	0.0	0.0	7.08
1	TRACTOR(DIESEL)	100.						2.77	2.77	0.07	2.01	2.35	4.43	7.20
	TOTAL COST/ACRE/FIELD				76.5	4.14	0.62	4.43	15.18 ***	0.10	2.90	3.39	6.39 ***	21.57 ***

Year 1987 Crop Enterprise Summary for Record # 187 for Red Spring Wheat Field # 1

Input	Physical Record	Acres	Cost/Acre	Total	Total	Total
Fuel & Lubrication		150.0 X	9.36	1403.45 V		
Repairs		150.0 X	16.98	2546.60 V		
Fertilizer	No Fertilizer Used					
Chemicals	No Chemicals Used					
Seed Costs Including Seed Cleaning	1.30 Bushels/Acre	150.0 X	6.18	926.25 V		
Labor	182.01 Hours @ 6.50	150.0 X	7.89	1183.10 V		
Interest on Operating Capital		150.0 X	2.15	322.76 V		
Taxes		150.0 X	4.43	664.50 F		
Machine Insurance		150.0 X	0.22	33.44 F		
Overhead, Miscellaneous		150.0 X	5.58	837.00 F		
Total Cash Costs		150.0 X	52.78		7917.09	
Investment in Land		150.0 X	50.13	7519.50 F		
Machinery & Building Investment		150.0 X	6.69	1003.31F		
Total Machinery & Building Depreciation		150.0 X	7.82	1173.46 F		
Total Non Cash Costs		150.0 X	64.64			9696.26
Total Cost		150.0 X	117.42			17613.35
Output (Price X Yield = 4.74 X 31.00)		150.0 X	146.94			22041.00
Net Returns to Management		22041.00 -	17613.35			4427.65
Returns to All Labor and Management		22041.00 -	17613.35 +	1183.10		5610.74
Returns to Investment Labor & Management		5610.74 +	1003.31 +	7519.50		14133.54
Returns to Investment Depreciation Labor and Management						15307.00

Year 1987 Crop Enterprise Summary for Record # 187 for Red Spring Wheat Field # 2

Input	Physical Record	Acres	Cost/Acre	Total	Total	Total
				Dollar Record		
Fuel & Lubrication		150.0 X	9.36	1403.45 V		
Repairs		150.0 X	16.98	2546.60 V		
Fertilizer	No Fertilizer Used					
Chemicals	No Chemicals Used					
Seed Costs Including Seed Cleaning	1.30 Bushels/Acre	150.0 X	6.18	926.25 V		
Labor	182.01 Hours @ 6.50	150.0 X	7.89	1183.10 V		
Interest on Operating Capital		150.0 X	2.15	322.76 V		
Taxes		150.0 X	4.43	664.50 F		
Machine Insurance		150.0 X	0.22	33.44 F		
Overhead, Miscellaneous		150.0 X	5.58	837.00 F		
Total Cash Costs		150.0 X	52.78		7917.09	
Investment in Land		150.0 X	50.13	7519.50 F		
Machinery & Building Investment		150.0 X	6.69	1003.31F		
Total Machinery & Building Depreciation		150.0 X	7.82	1173.46 F		
Total Non Cash Costs		150.0 X	64.64			9696.26
Total Cost		150.0 X	117.42			17613.35
Output (Price X Yield = 4.74 X 31.00)		150.0 X	146.94			22041.00
Net Returns to Management		22041.00 -	17613.35			4427.65
Returns to All Labor and Management		22041.00 -	17613.35 +	1183.10		5610.74
Returns to Investment Labor & Management		5610.74 +	1003.31 +	7519.50		14133.54
Returns to Investment Depreciation Labor and Management						15307.00

Year 1987 Crop Enterprise Summary for Record # 187 for Red Spring Wheat Field # 3

Input	Physical Record		Acres	Cost/Acre	Total	Total	Total
					Dollar Record		
Fuel & Lubrication			150.0 X	7.20	1079.84 V		
Repairs			150.0 X	14.43	2164.61 V		
Fertilizer	No Fertilizer Used						
Chemicals	No Chemicals Used						
Seed Costs Including Seed Cleaning	1.30 Bushels/Acre		150.0 X	6.18	926.25 V		
Labor	154.85 Hours @	6.50	150.0 X	6.71	1006.52 V		
Interest on Operating Capital			150.0 X	1.90	285.27 V		
Taxes			150.0 X	4.43	664.50 F		
Machine Insurance			150.0 X	0.22	33.44 F		
Overhead, Miscellaneous			150.0 X	5.58	837.00 F		
Total Cash Costs			150.0 X	46.65		6997.41	
Investment in Land			150.0 X	50.13	7519.50 F		
Machinery & Building Investment			150.0 X	6.69	1003.31F		
Total Machinery & Building Depreciation			150.0 X	7.82	1173.46 F		
Total Non Cash Costs			150.0 X	64.64			9696.26
Total Cost			150.0 X	111.29			16693.67
Output (Price X Yield =	4.74 X 31.00)		150.0 X	146.94			22041.00
Net Returns to Management			22041.00 -	16693.67			5347.33
Returns to All Labor and Management			22041.00 -	16693.67 +	1006.52		6353.84
Returns to Investment Labor & Management			6353.84 +	1003.31 +	7519.50		14876.64
Returns to Investment Depreciation Labor and Management							16050.10

Year 1987 Crop Enterprise Summary for Record # 187 for Red Spring Wheat Field # 4

Input	Physical Record	Acres	Cost/Acre	Total	Total	Total
Fuel & Lubrication		50.0 X	10.03	501.63 V		
Repairs		50.0 X	18.60	929.81 V		
Fertilizer	39.0 Cu.Ft/Acre Cattle Manure	50.0 X	5.08	253.86 V	253.86	
Chemicals	No Chemicals Used					
Seed Costs Including Seed Cleaning	1.30 Bushels/Acre	50.0 X	6.18	308.75 V		
Labor	64.41 Hours @ 6.50	50.0 X	8.37	418.65 V		
Interest on Operating Capital		50.0 X	2.49	124.28 V		
Taxes		50.0 X	4.43	221.50 F		
Machine Insurance		50.0 X	0.22	11.15 F		
Overhead, Miscellaneous		50.0 X	5.58	279.00 F		
Total Cash Costs		50.0 X	60.97		3048.63	
Investment in Land		50.0 X	50.13	2506.50 F		
Machinery & Building Investment		50.0 X	6.69	334.44F		
Total Machinery & Building Depreciation		50.0 X	7.82	391.15 F		
Total Non Cash Costs		50.0 X	64.64			3232.09
Total Cost		50.0 X	125.61			6280.71
Output (Price X Yield = 4.74 X 31.00)		50.0 X	146.94			7347.00
Net Returns to Management		7347.00 -	6280.71			1066.29
Returns to All Labor and Management		7347.00 -	6280.71 +	418.65		1484.94
Returns to Investment Labor & Management		1484.94 +	334.44 +	2506.50		4325.87
Returns to Investment Depreciation Labor and Management						4717.02

Year 1987 Crop Enterprise Summary for Record # 187 for Sweet Clover Se Field # 5

Input	Physical Record	Acres	Cost/Acre	Dollar Record Total	Total	Total
Fuel & Lubrication		150.0 X	4.76	713.35 V		
Repairs		150.0 X	4.43	664.32 V		
Fertilizer	No Fertilizer Used					
Chemicals	No Chemicals Used					
Seed Costs Including Seed Cleaning	7.00 Pounds/Acre	150.0 X	4.55	682.50 V		
Labor	76.45 Hours @ 6.50	150.0 X	3.31	496.94 V		
Rented Equipment Charges		150.0 X	6.00	900.00 V		
Interest on Operating Capital		150.0 X	1.41	212.16 V		
Taxes		150.0 X	4.43	664.50 F		
Machine Insurance		150.0 X	0.22	33.44 F		
Overhead, Miscellaneous		150.0 X	5.58	837.00 F		
Total Cash Costs		150.0 X	34.69		5204.21	
Investment in Land		150.0 X	50.13	7519.50 F		
Machinery & Building Investment		150.0 X	6.69	1003.31F		
Total Machinery & Building Depreciation		150.0 X	7.82	1173.46 F		
Total Non Cash Costs		150.0 X	64.64			9696.26
Total Cost		150.0 X	99.34			14900.46
Output (Price X Yield = 0.20 X 0.0)		150.0 X	0.0			0.0
Net Returns to Management		0.0 -	14900.46			-14900.46
Returns to All Labor and Management		0.0 -	14900.46 +	496.94		-14403.53
Returns to Investment Labor & Management		-14403.53 +	1003.31 +	7519.50		-5880.72
Returns to Investment Depreciation Labor and Management						-4707.26

Total Cost and Return Summary Per Field For Record Number 187 In 1987

	Type of Enterprise					
	Red Spring Wheat	Red Spring Wheat	Red Spring Wheat	Red Spring Wheat	Sweet Clover Se	Total
I. Acreage By Crop(acres)	150.	150.	150.	50.	150.	650.
II. Cost of Production						
1. Fuel & Lubrication	1403.45	1403.45	1079.84	501.63	713.35	5101.70
2. Repairs	2546.60	2546.60	2164.61	929.81	664.32	8851.94
3. Fertilizer	0.0	0.0	0.0	253.86	0.0	253.86
4. Chemicals	0.0	0.0	0.0	0.0	0.0	0.0
5. Seed Treatment Costs	0.0	0.0	0.0	0.0	0.0	0.0
6. Seed & Cleaning Cost	926.25	926.25	926.25	308.75	682.50	3770.00
7. Twine Costs	0.0	0.0	0.0	0.0	0.0	0.0
8. Labor	1183.10	1183.10	1006.52	418.65	496.94	4288.30
9. Custom Charges	0.0	0.0	0.0	0.0	0.0	0.0
10. Interest Oper. Cap.	322.76	322.76	285.27	124.28	212.16	1267.23
11. Crop Insurance Prem.	0.0	0.0	0.0	0.0	0.0	0.0
12. Drying Costs	0.0	0.0	0.0	0.0	0.0	0.0
13. Equipment Rentals	0.0	0.0	0.0	0.0	900.00	900.00
14. Rent	0.0	0.0	0.0	0.0	0.0	0.0
15. Taxes	664.50	664.50	664.50	221.50	664.50	2879.50
16. Machinery Insurance	33.44	33.44	33.44	11.15	33.44	144.92
17. Overhead, Misc.	837.00	837.00	837.00	279.00	837.00	3627.00
18. Total Cash Costs	7917.09	7917.09	6997.41	3048.63	5204.21	31084.42
19. Investment in Land	7519.50	7519.50	7519.50	2506.50	7519.50	32584.48
20. Invest. in Mach&Bldg	1003.31	1003.31	1003.31	334.44	1003.31	4347.66
21. Mach & Bldg Depr.	1173.46	1173.46	1173.46	391.15	1173.46	5084.99
22. Total Non Cash Costs	9696.26	9696.26	9696.26	3232.09	9696.26	42017.12
23. Total Cost	17613.35	17613.35	16693.67	6280.71	14900.46	73101.50
III. Gross Returns						
24. Average Yield/Acre	31.00	31.00	31.00	31.00	0.0	N/A
Breakeven Yield/Acre	11.14	11.14	9.84	12.86	173.47	N/A
25. Average Price	4.74	4.74	4.74	4.74	0.20	N/A
Breakeven Price	1.70	1.70	1.50	1.97	0.0	N/A
26. Crop Insur. Revenue	0.0	0.0	0.0	0.0	0.0	0.0
27. Straw ($/Acre)	0.0	0.0	0.0	0.0	0.0	0.0
28. Grazing ($/Acre)	0.0	0.0	0.0	0.0	0.0	0.0
Total Gross Returns	22041.00	22041.00	22041.00	7347.00	0.0	73469.87
IV. Net Returns to Mgmt.	4427.65	4427.65	5347.33	1066.29	-14900.46	368.45
V. Returns to Labor & Mgmt.	5610.74	5610.74	6353.84	1484.94	-14403.53	4656.73
VI. Returns to Investment Labor & Mgmt.	14133.54	14133.54	14876.64	4325.87	-5880.72	41588.87
VII. Returns to Investment Depr. Labor & Mgmt. or NET CASH RETURNS (See Note)	15307.00	15307.00	16050.10	4717.02	-4707.26	46673.86

Note: NET CASH RETURNS is defined as the amount of money left to pay for labor (family and hired), service long term debts, replace machinery as they depreciate and for management and profit.

Total Cost and Return Summary Per Field For Record Number 187 In 1987

Type of Enterprise

	Farm Average
I. Acreage By Crop(acres)	1.
II. Cost of Production	
1. Fuel & Lubrication	7.85
2. Repairs	13.62
3. Fertilizer	0.39
4. Chemicals	0.0
5. Seed Treatment Costs	0.0
6. Seed & Cleaning Cost	5.80
7. Twine Costs	0.0
8. Labor	6.60
9. Custom Charges	0.0
10. Interest Oper. Cap.	1.95
11. Crop Insurance Prem.	0.0
12. Drying Costs	0.0
13. Equipment Rentals	1.38
14. Rent	0.0
15. Taxes	4.43
16. Machinery Insurance	0.22
17. Overhead, Misc.	5.58
18. Total Cash Costs	47.82
19. Investment in Land	50.13
20. Invest. in Mach&Bldg	6.69
21. Mach & Bldg Depr.	7.82
22. Total Non Cash Costs	64.64
23. Total Cost	112.46
III. Gross Returns	
24. Average Yield/Acre	N/A
Breakeven Yield/Acre	N/A
25. Average Price	N/A
Breakeven Price	N/A
26. Crop Insur. Revenue	0.0
27. Straw ($/Acre)	0.0
28. Grazing ($/Acre)	0.0
Total Gross Returns	113.03
IV. Net Returns to Mgmt.	0.57
V. Returns to Labor & Mgmt.	7.16
VI. Returns to Investment Labor & Mgmt.	63.98
VII. Returns to Investment Depr. Labor & Mgmt. or NET CASH RETURNS (See Note)	71.81

Note: NET CASH RETURNS is defined as the amount of money left to pay for labor (family and hired), service long term debts, replace machinery as they depreciate and for management and profit.

Cost and Return Per Acre Per Crop For Record Number 187 In 1987

	Red Spring Wheat	Sweet Clover Se	Farm Average
I. Acreage By Crop(acres)	500.	150.	1.
II. Cost of Production			
1. Fuel & Lubrication	8.78	4.76	7.85
2. Repairs	16.38	4.43	13.62
3. Fertilizer	0.51	0.0	0.39
4. Chemicals	0.0	0.0	0.0
5. Seed Treatment Costs	0.0	0.0	0.0
6. Seed & Cleaning Cost	6.17	4.55	5.80
7. Twine Costs	0.0	0.0	0.0
8. Labor	7.58	3.31	6.60
9. Custom Charges	0.0	0.0	0.0
10. Interest Oper. Cap.	2.11	1.41	1.95
11. Crop Insurance Prem.	0.0	0.0	0.0
12. Drying Costs	0.0	0.0	0.0
13. Equipment Rentals	0.0	6.00	1.38
14. Rent	0.0	0.0	0.0
15. Taxes	4.43	4.43	4.43
16. Machinery Insurance	0.22	0.22	0.22
17. Overhead, Misc.	5.58	5.58	5.58
18. Total Cash Costs	51.76	34.69	47.82
19. Investment in Land	50.13	50.13	50.13
20. Invest. in Mach&Bldg	6.69	6.69	6.69
21. Mach & Bldg Depr.	7.82	7.82	7.82
22. Total Non Cash Costs	64.64	64.64	64.64
23. Total Cost	116.40	99.34	112.46
III. Gross Returns			
24. Average Yield/Acre	31.00	0.0	N/A
Breakeven Yield/Acre	10.92	0.0	N/A
25. Average Price	4.74	0.0	N/A
Breakeven Price	1.67	0.0	N/A
26. Crop Insur. Revenue	0.0	0.0	0.0
27. Straw ($/Acre)	0.0	0.0	0.0
28. Grazing ($/Acre)	0.0	0.0	0.0
Total Gross Returns	146.94	0.0	113.03
IV. Net Returns to Mgmt.	30.54	-99.34	0.57
V. Returns to Labor & Mgmt.	38.12	-96.02	7.16
VI. Returns to Investment Labor & Mgmt.	94.94	-39.20	63.98
VII. Returns to Investment Depr. Labor & Mgmt. or NET CASH RETURNS (See Note)	102.76	-31.38	71.81

Actual 0.512 % Returns on Capital

Note: NET CASH RETURNS is defined as the amount of money left to pay for labor (family and hired), service long term debts, replace machinery as they depreciate and for management and profit.