ZERO TILLAGE AND ORGANIC FARMING IN SASKATCHEWAN:
AN INTERDISCIPLINARY STUDY OF THE DEVELOPMENT OF
SUSTAINABLE AGRICULTURE

A Thesis Submitted to the College of Graduate Studies and Research
in Partial Fulfillment of the Requirements for
the Degree of Doctor of Philosophy
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by
Mary Anne Beckie

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ABSTRACT

The purpose of this research was to investigate how sustainable agriculture is being conceptualized and implemented in Saskatchewan. Zero tillage, organic farming, and the discourses surrounding them were examined as theoretical and practical responses to sustainable agriculture. Characteristics of 33 organic and 33 zero tillage farming systems located throughout the soil climatic zones of southern Saskatchewan were compared, as well as farmers’ perceptions of sustainable agriculture and factors influencing their management decisions. The analysis was extended beyond the local level by examining the links between major socio-political forces shaping agriculture and farmers’ perceptions and choices. Central to this analysis is an examination of the role of informal and formal knowledge systems in the development of sustainable agriculture, and how relations of power affect the knowledge that is being produced and ultimately the direction of change in agriculture. Interdisciplinary and exploratory approaches were used to identify and examine a range of emergent issues. The data gathered was analyzed both quantitatively and qualitatively.

This study revealed commonalities between zero tillage and organic farmers’ goals and basic views on sustainable agriculture, and important differences in the ways these two groups of farmers translated these ideas into practice. Most farmers defined sustainability at the farm-level, focusing on land stewardship and the preservation of the family farm. Farmers adopted zero tillage because of specific environmental, economic and labour advantages, whereas organic farming was adopted for a combination of environmental, health, economic, philosophical/spiritual and labour factors. In general, zero tillage and organic farming systems differed in size, in production and management operations, in land tenure, and in the use of purchased inputs and labour. Zero tillage farms tended to be large, capital-intensive, specialized cropping operations, with a significant proportion of rented land and non-family hired labour. Organic farms were moderate-sized diversified crop and livestock operations that substituted biological and cultural practices for purchased (agrochemical) inputs, had a high degree of ownership and relied more upon labour exchange. These characteristics create distinct environmental, economic and social advantages and disadvantages. Zero tillage, compatible with the dominant agricultural paradigm and the industrial model, continues to be promoted by agricultural institutions and
agribusiness as the best solution to farm-level sustainability. Interest in organic agriculture and the alternative agricultural paradigm is increasing, however, due to the current crisis in the farm economy and changes in consumers’ perceptions and choices.
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Many friends and colleagues for informing, supporting and inspiring me. Special thanks to Glen Padbury for information and advice on matters related to provincial soils and farming practices, Stephen Bowkett and Daniel Mittelholtz for technical advice and assistance, Cathy Holtslander for editorial suggestions and for introducing me to Antonio Gramsci, and Carla Barber for providing a brief but valuable refuge for writing;

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DEDICATION

This work is dedicated to my father, Nicholas J. Beckie, and to the memory of my mother, Cecilia K. Beckie, for giving me the opportunity to experience the richness of growing up on our farm and in our community, and for instilling in me a love of the land and people of rural Saskatchewan.
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CHAPTER 1: INTRODUCTION

1.1 The Problem

For most of this century farming on the Canadian Prairies has focused on increasing production and labour efficiency through improvements in technology and technique. This has been accompanied by increasing use of capital inputs such as fossil fuels, synthetic fertilizers and pesticides, patented genetic stock, machinery and other technologies. This modernization or industrialization of prairie agriculture has given rise to a number of accomplishments, from technical innovations to increases in crop yields. Some of this progress, however, has occurred at the expense of ecosystems and communities. Environmental impacts are widespread due to the industrialization of agriculture here and elsewhere, resulting in changes at the ecosystem level (e.g., loss of soil and water quality, biodiversity, and natural habitat) as well as influencing environmental sustainability at the global level (e.g., depletion of fossil fuels and climatic change) (Matson et al. 1997). In addition to these environmental effects, increasing mechanization and the use of certain agrochemicals has been linked to increased health risks for farmers, farm families and farm labourers (Hardell and Eriksson 1999, McDuffie et al. 1995). The structure and viability of family farms and rural communities are also threatened by industrial progress in agriculture (Atkinson 1988, Berry 1977, Gertler 1999, Lind 1995, Strange 1988). Local control over production processes and markets is decreasing, while dependence on industrial inputs and long-distance markets intensifies (Bonanno et al. 1994, Diaz and Stirling 1989, Winson 1993). As agriculture is increasingly drawn into the global economy, the role of social and political institutions of the state is declining (Hart 1995, Juillet et al. 1997). Transnational corporations controlling agricultural inputs, processing and trade are now the major players affecting change (Heffernan and Constance 1994).

Within the context of these local and global changes, a debate about the sustainability of agriculture is taking place. There is general agreement that changes are needed if agriculture is to remain
viable. There is, however, a range of views as to what future goals and directions should be. Some support the fundamental principles of industrial agriculture and believe that environmental problems can be solved with technical improvements and that social and economic issues will be sorted out in the marketplace (e.g., Avery 1997). At the other end of the spectrum there are those calling for radical restructuring of the entire food system, based upon ecological principles and the restoration of local economies and communities (e.g., Berry 1977, Ikerd 1999, MacRae et al. 1990). Given the range and polarization of options for the future of agriculture, how will it be determined who and what should be sustained and how do we develop the mechanisms to achieve these goals?

In 1990, the Canadian government made a commitment to promote the development of sustainable agriculture and since then work has been done by the state to define sustainability and address key problems. In Saskatchewan, a major effort is underway to convince farmers to adopt an alternative model of crop production in order to solve targeted environmental and economic problems. Within this model, zero tillage or no-till is being championed as the way to reduce soil erosion, retain soil moisture, improve soil quality, increase yield, as well as reduce field labour, machinery and fuel costs. As a result of extensive research, development and promotion of zero tillage by both public and private sectors, the rate of adoption of this practice is higher in Saskatchewan than elsewhere in Canada. According to the recent census of agriculture, from 1991 to 1996 the amount of land under zero tillage management more than doubled from 3.3 million acres to 7.3 million acres or 22 percent of the total seeded land area in the Province (Statistics Canada 1997). Government documents and the agricultural media point to the significant increases in this practice as an indication that farm management and production methods are changing to ensure that agriculture is sustainable, both environmentally and economically (e.g., Agriculture and Agri-Food Canada 1996, 2000). Negative impacts associated with this practice are often omitted or down-played in these assessments of the sustainability of this practice, including increases in pesticide resistance and the risks for human and ecosystem health associated with increased use of agrochemicals. The transition to zero tillage is associated with high capital costs for specialized and large-scale machinery. The technologies and techniques of zero tillage facilitate increased field and farm size and other structural changes in rural communities.
Organic farming, a management intensive and low external input alternative to conventional agriculture, has received comparatively little attention from agricultural institutions in Saskatchewan. Yet the most recent national survey indicates that Saskatchewan has the highest rate of adoption and the second highest number of organic farmers in Canada (Macey 1997). Studies have shown that by eliminating agrochemicals and relying upon a selection of appropriate cultural and biological practices, organic farming systems can provide environmental and economic benefits. Soil quality of organically farmed land compares favourably with land farmed conventionally (National Research Council 1989, Gameda et al., 1998, Reganold 1988, Rutherford et al. 1992). A lower cost of production and premium prices for organic products can create economic advantages for organic farmers (Henning 1994, Rutherford et al. 1992). A wider range of ecological and socio-economic benefits has also been suggested, as organic farms tend to be smaller in size and have more diversified production (Bateman 1994). The major disadvantages of the organic approach that are frequently cited include increased labour and management requirements, the use of mechanical tillage for weed control (and associated effects on soil erodibility and soil quality), and lower yields associated with the absence of agrochemicals (Lampkin 1994, Rutherford et al. 1992).

There appear to be positive and negative aspects of both of these approaches to more sustainable production, but agricultural institutions in Saskatchewan have focused almost exclusively on approaches involving high external input, such as zero tillage, precision farming and biotechnology. These approaches are compatible with a scientific/industrial approach to agricultural development. This has been the dominant model in Saskatchewan and elsewhere for most of this century, but in recent decades there have been a growing number of people concerned about the socio-economic and environmental problems associated with this model. This concern has given rise to an alternative agricultural paradigm. Advocates of this paradigm are creating a social movement in which dominant theories and approaches in agriculture are critically examined, based upon criteria such as resource limits, environmental degradation, food quality and safety, the relationship between increasing capitalization, consolidation and the decline of family farms and rural communities, and decreasing biodiversity. As a result of this analysis, theoretical and practical alternatives for sustainable agriculture are being developed and promoted.
It is ten years since Canada made a commitment to promote sustainable agriculture. Given the distance we have come with the dominant model of agricultural development in Saskatchewan and the local and global resistance to it, it is time to re-examine and evaluate the goals and approaches to sustainable agriculture that are being presented. If we recognize that there are diverse and potentially conflicting theories and practices for sustainability, then we must look closely at whose interpretations or models prevail and under what conditions. There is a need to examine how the relationship between knowledge and power is shaping definitions of and approaches to sustainable agriculture in Saskatchewan.

1.2 Purpose and Objectives

The purpose of this research is to investigate how sustainable agriculture is being conceptualized and implemented in Saskatchewan. Zero tillage and organic farming are two alternative crop production practices being adopted in Saskatchewan in response to problems associated with conventional production methods. In this study I examine these alternative farming practices, and the discourse surrounding each of them, as theoretical and practical responses to sustainable agriculture. This research provides an opportunity to investigate the roles of farmers, scientists, agribusiness firms, governments, consumers and social movements in the construction of sustainable agriculture.

Experts working within scientific and economic frameworks are developing the dominant model for sustainable agriculture in Saskatchewan. Quantitative investigations of productivity, profitability and selected environmental parameters are being used to evaluate the sustainability of different farming systems. Farmers have been assigned a subordinate role in this process even though they play a central and strategic role in agroecosystems.¹ In developing this study I recognized the need to investigate farmers' perspectives on sustainable agriculture and the ways in which they put theory into practice at the field-level.

Family farms are still the basic units of agricultural production in Saskatchewan. Farming practices can be seen as the central activity linking the socio-economic aspects of production (e.g.,

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¹ An agroecosystem is defined by all the ecological, social, economic and technical elements that play an integral and interactive role in a dynamically changing system.
personal and cultural values, methodology, technology, input costs, markets) with the biophysical aspects of the agroecosystem (e.g., soil, climate, topography). The practice of farming is also the fundamental process by which local agricultural knowledge is developed. Production practices are, therefore, a logical starting point for examining the integration of essential components within agroecosystems and for studying how farmers develop the knowledge that enables them to respond to various local and non-local factors in their attempts to build sustainable farming systems.

I have grounded this work at the farm-level. I examine characteristics of organic and zero tillage farmers and farming systems, analyze how these characteristics influence the adoption, development and reproduction of these alternative practices, and document farmers’ perceptions about sustainable agriculture. The analysis also extends beyond the farm gate, to examine links between farmers’ choices and perceptions (the local construction of these farming systems) and the major social and political forces shaping agriculture.

More specifically, the objectives of this research are:

1. To compare and contrast the development of two alternative crop production practices, zero tillage and organic farming, in Saskatchewan.

2. To analyze the influence of micro-level characteristics of farmers and their farming systems on the adoption and development of these alternative farming practices.

3. To investigate how macro-level factors—public agricultural institutions, private agribusiness firms, consumer demands, and the sustainable agriculture movement—have also influenced the development of these alternative production systems.

4. To critically examine how theories and practices for sustainable agriculture are being socially constructed and evaluated in Saskatchewan.

In pursuit of these objectives this study moves beyond the prevalent focus on specific environmental and economic parameters of farming systems, to address the social and political processes shaping these systems and the development of sustainable agriculture. Who is selecting the criteria and priorities for sustainable agriculture? Whose knowledge is considered valid? What and who will be
sustained? How are relations of power affecting the social construction of sustainable agriculture in Saskatchewan?

1.3 Theoretical Perspective

1.3.1 Dominant Approaches to the Study of Agriculture

Institutions of agriculture science involved in education, research and extension (e.g., Agriculture and Agri-Food Canada, the Prairie Farm Rehabilitation Administration (PFRA), the National Research Council (NRC), the College of Agriculture and the Western College of Veterinary Medicine at the University of Saskatchewan, Saskatchewan Department of Agriculture and Food) have played a central role in determining the theoretical and methodological perspectives that have shaped the modernization of Saskatchewan agriculture. These federal and provincial institutions continue to play an influential role in determining future directions in Saskatchewan agriculture. Traditional approaches to the study and development of agriculture are productivist/utilitarian, positivist, and reductionist or discipline-oriented. The number and diversity of disciplines included in public agricultural institutions in the United States and Canada varies, but in Saskatchewan they are limited to the applied natural sciences (e.g., Soil Science, Plant Science, Animal Science) and agricultural economics. This disciplinary focus on biophysical and economic parameters of agriculture has facilitated the concentration of public resources on maximizing agricultural productivity through the application of scientific and technological advances. Other ecological, social and political aspects of agriculture have been relatively neglected as a result of the dominant structural and theoretical perspective (e.g., Fairbairn 1990, Friedland 1991, Rowe 1990).

Within mainstream agricultural institutions, farming is predominantly viewed as a technical activity and farmers as seen as the recipients and practitioners of knowledge produced by scientists and transferred to the farming community by extension agencies. This model of knowledge construction and dissemination, known as diffusion of innovations or transfer of technology (ToT), has been the dominant model throughout North America (Rogers 1983). This is a hierarchical model, in which scientific and technological innovations produced by experts are considered to be beneficial and necessary to the
progressive modernization of agriculture. Farmers who resist or are slow to adopt these technologies are identified as ‘laggards’ or poor farmers, as opposed to the ‘innovators’ or early adopters.

Over the past two decades, persistent and escalating social, economic and environmental problems associated with a conventional approach to agricultural development have been identified and examined. This analysis has led to critical re-evaluation of this model and challenges to traditional theoretical and methodological perspectives on agriculture (e.g., Chambers 1983, Hightower 1973, Kloppenburg 1991, MacRae et al. 1989, National Research Council 1989, Science Council of Canada 1992). These challenges are eliciting certain changes within agricultural institutions.

The disciplinary orientation still prevails within agricultural institutions but in recent years there has been increasing emphasis placed on systems-level analysis in which various components of agroecosystems are measured and analyzed through more integrative approaches. To facilitate this process, multidisciplinary research teams are formed to select criteria or indicators of sustainability and to identify ways to optimize these aspects of the system. Criteria commonly analyzed in these studies include productivity, profitability, and environmental impact (e.g., soil and water quality, biodiversity, pest dynamics). Various methods (e.g., Farming Systems Research (Ashby et al. 1989), Agroecosystem Analysis (Conway 1985), and computer models such as EPIC (Williams et al. 1983)) have been developed to accumulate, integrate and analyze data identified as relevant to sustainability. Although these methods are labeled as more holistic and integrative, the emphasis on economic and technical aspects of agricultural production prevails, as does the commitment by the institutions to conventional utilitarian/productivist goals for agriculture. These approaches fail to adequately address the broader range of ecological and social goals that have been identified for agricultural sustainability, such as

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2. Systems-level analysis has been used recently in two major research projects, funded by the Canada-Saskatchewan Agricultural Green Plan Agreement, that compare the sustainability of farming systems in Saskatchewan. Assessing Alternative Crop Production Systems for the Canadian Prairies (Brandt et al. 1997) is based on analysis of data gathered from farm level and field plot analysis. The Sustainability of Farming Systems in Saskatchewan (Garneda et al. 1998) is based on computer modeling from simulation data. In both of these projects, indicators of sustainability have been identified within specific environmental and economic parameters, and the farming systems are quantitatively evaluated for sustainability according to these parameters.
ecological and genetic diversity, the preservation of family farms and rural communities, greater regional self-sufficiency, health and food safety, and democratic participation.

In recent decades there has been widespread interest in a participatory or ‘Farmer First’ approach to agriculture research and extension (Chambers 1983, 1997). This approach challenges the traditional hierarchical model of knowledge construction and dissemination in agriculture. Farmers are not viewed as passive recipients of knowledge created externally but as actively engaged in creating and exchanging knowledge. Advocates of this approach maintain that farmers’ knowledge and experience are valuable and under-utilized resources which should be acknowledged and included in the formal knowledge system. Due to the popular appeal of ‘Farmer First’ theory and methodology, many agricultural institutions claim to have incorporated a participatory approach in their research and extension work. The nature and extent of farmer participation, however, varies greatly in these projects or programs. Generally, a ‘hard science’ or ‘hard systems’ methodology remains dominant, involving structured and quantitative investigation, initiated and directed by researchers (Scoones and Thompson 1994). Farming continues to be seen as a technical activity that can be adjusted and improved, through the application of scientific and technological knowledge, to meet externally determined criteria of sustainability.

1.3.2. Points of Departure

Conceptualizing farming as a technical activity obscures the social, cultural and political dimensions of both farming systems and agricultural institutions. Those who take a critical perspective on the social construction of agriculture argue that it is not only determined by technical inputs, economic and environmental conditions, but also by existing relations of power. These social relations influence the opportunities available for different actors to respond to and initiate change. Agriculture, then, is seen as a complex social process in which resources and inputs are manipulated and managed in response to the socio-political, economic and biophysical context.
Within this critical perspective, farming is viewed as more than commodity production. It also gives rise to a diversity of local knowledges, both theoretical and practical in nature, which constitute an informal knowledge system. In addition to creating and exchanging information with each other, farmers interact with the formal knowledge system represented by agricultural institutions. Encounters between these knowledge systems take place in agriculture research and extension. As these interactions involve individuals and groups with different interests and different levels of resources, specific relations of power are formed. The social relations of production extend further, to include corporate agribusinesses, international trade arrangements and consumers. There is, therefore, a whole set of specific relations that shapes the production process and influences the distribution of goods and wealth. Ian Scoones and John Thompson (1994) contend that if agriculture is to be treated as the social process it is, these key factors must be considered: 1) the diversity or heterogeneity of values and goals, knowledge and experience within agricultural systems, that is, different actors hold different versions of "the truth"; 2) the nature of interactions between people, organizations, institutions, industry and the state; 3) issues of power, control, conflict and resistance.

In this study I explore how social and political forces are influencing the development of two alternative approaches to farming and agricultural sustainability in Saskatchewan. Central to this analysis is an examination of the role of informal and formal knowledge systems in the development of sustainable agriculture, and how relations of power affect the knowledge that is being produced and ultimately the direction of change in agriculture. In the perspective I have adopted, sustainable agriculture is seen not as an absolute but as a process through which knowledge is constructed, negotiated and re-negotiated over time, with contributions from many different actors and agencies. Theoretically, this thesis is influenced by the critical perspectives of Michel Foucault and Antonio Gramsci on the relationship between knowledge and power, and also by the analysis of a number of other social theorists who have critically examined the factors influencing change in agriculture. In the following sections I briefly outline the theoretical framework employed in this thesis. Further development of theoretical issues is woven throughout the thesis.
1.3.3 Knowledge and Power: A Theoretical Framework for a Critical Analysis of Sustainable Agriculture

Knowledge and power are ever present and ever changing factors affecting the development of agriculture (Busch et al. 1995, Kloppenburg 1991, Scoones and Thompson 1994). According to Foucault (1980), what constitutes knowledge, what is to be excluded, and who is designated as qualified to know, all involve acts of power. As a result of the interplay between knowledge and power, dominant and subordinate positions are created and occupied. Throughout this thesis I refer to institutions of agricultural science as part of the formalized and dominant knowledge system, which has been instrumental in the modernization and industrialization of agriculture. Relative to this formal knowledge system in agriculture, the informal knowledge developed by farmers occupies subordinate positions. These categories and the relationship between them require further explanation.

1.3.3.1 The Informal Knowledge System: Farmers' Knowledge

What I refer to as farmers' knowledge is also identified (here and elsewhere) as indigenous, local, or rural people's knowledge. By identifying farmers as creators of legitimate knowledge, both theoretical and practical in nature, I support the position that farming is a form of praxis. Gramsci (1971) defines praxis as the reflective and progressive cycle of learning and action, of theory and practice, that is central to social change. Without action, theory is untested and change cannot take place; without reflective analysis, action runs the risk of being ineffective. Through the practice of farming, farmers respond to varying personal, social, economic, and environmental conditions. Thereby they develop theoretical knowledge that is continually evolving and influencing modifications to the farming practice and to the farming system. Farmers are seen, then, as centrally situated agents or strategizers in local agroecosystems, actively engaged in the generation, acquisition, and linking of knowledge of the environment, economics and culture with methodology and technology. The success of a farming system is profoundly contingent upon the creation and evolution of this local knowledge.

Farmers' knowledge is locally situated and therefore affected by local biophysical and socio-economic factors. Other non-local factors, such as government policy, markets, agribusinesses and
institutions of agricultural science, also impact upon the knowledge that is being created. These local and external factors present both obstacles and opportunities for farmers, creating what Jan van der Ploeg (1990, 1992) identifies as “room to manoeuvre.” Differences in farming systems are the result of differences in farmer strategy and access to internal and external resources. Van der Ploeg contends that heterogeneity is everywhere a structural feature of simple commodity production (family farm enterprises) and that it is of critical importance to the sustainability of local agroecosystems. Conventional approaches to agricultural research and extension attempt to simplify and standardize farming practices and systems. They fail to acknowledge and document the benefits that heterogeneity in local knowledge, skills and experience holds for sustainability. Although this study follows a standard classification of farming practices, the research revealed a rich diversity of approaches and knowledge being created within the farming systems investigated. I explore how various micro-level and macro-level factors are shaping the room to manoeuvre at the local level in Saskatchewan, and the implications of emerging trends for the sustainability of local agroecosystems.

1.3.3.2 The Formal Knowledge System: Agriculture Science

The formalized system of knowledge in agriculture is also identified as the scientific knowledge system. “Science” can be used as a general term to describe any body of knowledge organized in a systematic way. In this thesis I refer to the agricultural sciences as part of the specialized, professionalized institution of Western science in which there is a similarity of philosophies, structures and practices. These form what Foucault (1977: 191) calls an “episteme.” It is a self-evaluating and self-perpetuating knowledge system with specific vocabularies, symbols and procedures (Franklin 1990). The prevalent ideology in this episteme is based upon a utilitarian and productivist view of nature (Aronowitz 1988). Science claims to objectively and neutrally develop knowledge in order to understand, manage and control natural processes and thus to improve the material conditions of existence. The epistemology of science features a positivist and reductionist approach to knowledge (MacRae et al. 1989). Complex phenomena are reduced to a relatively small number of quantifiably measurable variables.
In this thesis I examine critical perspectives on the ideology, epistemology and practice of agricultural science, particularly as these give rise to and shape the dominant discourse on sustainable agriculture. Discourse is perceived here as more than the formal written or spoken text relating to sustainable agriculture. It is also “embodied in technical processes, in institutions, in patterns of general behavior, in forms of transmission and diffusion, and in pedagogical forms which, at once, impose and maintain” (Foucault 1977: 200). Theories and practices prevalent within agricultural institutions are the focus of the analysis of dominant discourse developed in this study. This research also revealed that these institutions consist of individuals with many different and sometimes conflicting views and approaches, but due to relations of power some have achieved dominance over others.

1.3.3.3 The Nature of Knowledge and Power

Scoones and Thompson (1994) comment that farmers’ knowledge is often characterized as highly specific and contextually bound knowledge emerging from localized, practical experience. In contrast, agriculture science is seen as theoretically based and providing objective, generalizable knowledge. As a result of these characterizations and the prevalent belief in western society that a professional, specialized and theoretically based approach to knowledge is superior to practical and experiential knowledge, the scientific or formal knowledge system has achieved a position of dominance. Scoones, Thompson and others (e.g., Chambers 1988, van der Ploeg 1992, Kloppenburg 1991) contend that any simplistic contrast between these two knowledge systems is inadequate.

Both farmers’ knowledge and agriculture science proceed with context-determined, experiential and theoretical knowledge reinforced by continuous interactions between theory and practice. They are both general and specific, theoretical and practical. Both are value-laden, context-specific and influenced by social relations of power (Scoones and Thompson 1994: 29).

Knowledge has been placed here into distinct categories and positions of dominance or subordination. Knowledge, whether local or scientific, is, however, never discrete, uniform, or static. Rather, it is constructed, negotiated and contested in varying social and ecological settings (Long 1984). Knowledge evolves through “the discontinuous, diffuse and value-bound interactions of different actors and networks, it is a process of both interpretation and negotiation” (Long and Villareal 1994:49).
Classifications such as local or scientific are static and do not reveal the heterogeneity within these categories, the cross-influences between categories, and the relations of power that exist within and between these knowledge systems.

The existence of a powerful formal knowledge system in agriculture, therefore, does not exclude opportunities for other knowledge and power to exist, through which competing forms of legitimacy, control, resistance and change are created. Knowledge is, then, a fluid, ever-changing outcome of complex social processes. The concept of hegemony, as developed by Gramsci (1971), has been used to describe and analyze how the dynamic relationship between knowledge and power shapes the direction of change in agriculture (Allen 1993, Hassanein 1999, Kloppenburg 1991, 1992).

1.3.3.4 The Concept of Hegemony

Gramsci defines hegemony as the existence of a powerful ideological and material force that emerges from the complex interaction of historical factors, such as culture, language, religion, educational and economic systems (Gramsci 1971). Greer (1982) provides a comprehensive and useful description of the concept of hegemony.

It is … "the permeation throughout society... of an entire system of values, attitudes, beliefs, morality, etc., that is one way or another supportive of the established order and the class interests that dominate it....For hegemony to assert itself most successfully in any society, it must operate in a dualistic manner: as a 'general concept of life' for the masses and as a 'scholastic programme" (Greer 1982:305).

Although hegemonic forms of domination are powerful and pervasive throughout society, Gramsci contends that contradictions or problems will inevitably emerge. Critical interpretation of these contradictions exposes hegemonic ideology and authority as socially constructed, problematic and oppressive for some, thereby allowing alternative ideologies and approaches, along with possibilities of resistance, to emerge (Holtslander 1998).

The hegemony of the formal scientific knowledge system in Western culture and the subordination of other knowledge systems have been the subject of critical analysis by feminists, ecologists, sociologists and other social theorists during the past few decades.
Despite the existence of many valid forms of knowledge, science has achieved the status of the modern epistemic hegemon, that standard against which all other knowledge claims are compared to (Kloppenburg 1992: 98).

Scientific constructs have become the model for describing reality rather than one of the ways of describing life around us (Franklin 1990:39).

Deconstructive analysis of the basic assumptions of science has revealed contradictions in its ideology, epistemology and practice. Although it claims to develop an objective, rational and neutral understanding of natural phenomena, science has been exposed as an ideology that is continually influenced by cultural values, and by political and economic forces (Aronowitz 1988, Busch et al. 1995, Kuhn 1970, Latour 1986, Longino 1990). Kloppenburg asserts that science has become “inextricably linked to the forces of industrial capitalism” (1992: 104). Historical analysis has shown that commonalities and compatibilities between science and industrial capitalism became apparent during the industrial revolution, when the implementation of rational forms of thought and social organization created a technological and cultural revolution (Aronowitz 1988, Jacob 1997). Since that time, ideological, economic and political ties between these two social forces have evolved and strengthened, making the scientific/industrial approach to development the dominant universal model.

Critics also argue that in addition to science being socially constructed and influenced by economic and political forces, science is also an agent of social and structural change (e.g., Busch 1994, Diaz and Stirling 1989, Kloppenburg 1991, van der Ploeg 1992). According to van der Ploeg (1992), a scientific/industrial approach attempts to ‘standardize’ or ‘homogenize’ agricultural production to gain greater control over natural processes and products, in order to increase productivity and profits. As the science-industry alliance continuously pushes the productive limits of agroecosystems, production is increasingly distanced from local factors. Van der Ploeg contends that this separation threatens the sustainability of family farms, rural communities and local agroecosystems.

In a recent critique of dominant trends in Canadian agriculture, Hall (1998) asserts that the state, public institutions of agriculture science, and the agribusiness sector have aligned to promote a particular version of sustainability that involves making technical adjustments to the dominant/hegemonic model of agricultural development. This version of sustainable agriculture appears to address environmental
concerns while also meeting economic demands of dominant capitalist forces. Hall (1998) claims that this is an example of what Gramsci (1971) identified as "reproducing hegemony." To "reproduce the hegemony" of the dominant model in agriculture, it has been refashioned in order to make it appear to be sustainable and therefore acceptable.

1.3.3.5 Resistance to the Hegemony of a Scientific/Industrial Model of Development

According to Gramsci, critical interpretation of the contradictions in hegemonic rule creates theoretical spaces for counter-hegemonic knowledge to develop and political places in which relations of power can be challenged and resisted. Throughout the history of agriculture in Saskatchewan, farmers have found ways to resist control by dominant economic and political forces in agriculture (Holtslander 1998, Faller 1998, Taylor 1994). This resistance has been expressed through the production and labor decisions of individual farm households, through the collective production, labour, processing and marketing strategies of farm households, and through the formation of agrarian organizations and movements aimed at modifying government policy.

During the past few decades resistance to the hegemony of the dominant model of agricultural development has gone beyond the farm gate. A growing number of consumers are questioning the environmental and health risks associated with the processes and products of an industrial approach in agriculture. Many people are also concerned about the social consequences of this approach for family farms and rural communities. Recognition of these contradictions in the dominant model of agriculture has led to the elaboration of an alternative agricultural paradigm and to the formation of a worldwide sustainable agriculture movement. Partisans of this movement are calling for a re-localization of agriculture – from production through to processing and marketing – which they believe will generate opportunities for real sustainable development. A principal focus of this new social movement is the "resurrection and reactivation of local and subjugated knowledges" (Foucault 1994: 205) in order to

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3. The strongest consumer opposition to this model is situated in Europe where distrust of the agricultural establishment coalesced during incidents that brought into question the safety of the food supply, such as the case of Britain's experience with Bovine Spongiform Encephalopathy (BSE) or mad cow disease (Carr 1999). Further discussion of the impacts of this and other food scares are discussed in more detail in
democratically re-evaluate and redefine values and goals for agriculture that are more in keeping with the principles of ecology and social equity. The dominant discourse on sustainability espouses technoscientific, and macro-economic solutions to current problems in development. Within the alternative discourse, sustainability is perceived as a normative concept, therefore, there is an emphasis on the fundamental importance of human agency and human rights, specifically the right to know and the right to participate in conceptualizing and constructing sustainability at the local level. From this perspective, democratic participation is viewed as the foundation upon which sustainability must be built (e.g., Allen 1993, Irwin 1995, Redclift 1993, Wainwright 1994).

There will be no ‘sustainability’ without a greater potential for citizens to take control of their own lives, health and environment. However, success in this goal requires some careful thought about the relations between scientific and technical expertise, citizen knowledge and needs and contemporary culture (Irwin 1995:7).

Redclift warns that if we do not actively engage in a critical analysis of the ways that relations of power shape our relationship to the environment and, perhaps more importantly, our relationships with one another with respect to the environment, “we are in danger of drowning in our own rhetoric” (Redclift 1993:184). Allen adds that analysis of these social and political processes is fundamental to the reformulation of a “democratic epistemology” for sustainability (Allen 1993:1). She maintains that the consequent “reformation of theory and practice” will prevent reproducing the ecological and social problems of the current system and will enable us to develop policies and practices for democratic and sustainable agricultural systems.

1.3.3.6 Revisiting Sustainable Agriculture

Definitions of sustainable agriculture consistently identify three dimensions—the social, ecological, and economic—as essential and interwoven elements in the equation for sustainability. Yet, in Saskatchewan and elsewhere, a dominant model of agricultural development emphasizes certain environmental and economic variables, while many socio-political elements are neglected or ignored. This approach overlooks or trivializes the crisis occurring in rural communities and fails to recognize the
significance of local knowledge for achieving sustainability. It also underestimates the strength of the resistance that is being formed globally in opposition to this model of development. Agriculture developed as a way to sustain human life, but an increasing number of people believe that the dominant scientific/industrial approach to agriculture is not benefiting or sustaining many of those it should be serving including family farmers, rural communities, consumers concerned about food quality and safety, and those without the resources to obtain adequate supplies of food. Who, then, is benefiting from agricultural development? Can sustainability be achieved without recognizing and enhancing human as well as ecological resources?

It is time to revisit the dominant and alternative discourses on sustainable agriculture, to examine how relations of power shape the theory and practice of sustainable agriculture in Saskatchewan. Perhaps most importantly, it is time to listen to what farmers, as central and strategic actors in agroecosystems, have to say about sustainable agriculture. Kloppenburg contends that there is “a landscape of local and sustainable solutions being created by farmers, rendered invisible by the hegemony of the scientific knowledge system and the industrial approach to agricultural development” (Kloppenburg 1992: 100). This study provides an opportunity to investigate and make visible this local landscape where zero tillage and organic farming are being adopted as sustainable solutions. The way in which characteristics of farmers and their farming systems have shaped these local constructs are examined, and also the extent to which these farmers have been influenced by and are resisting or fomenting change in the dominant and alternative discourses on sustainable agriculture.

1.4 Methodology and Methods

1.4.1 An Interdisciplinary and Exploratory Approach

Irwin suggests we need to examine “the linkages between ways of knowing and ways of doing” in our attempt to achieve more sustainable approaches to development (Irwin 1995: 169). “The challenge,” he says, “is not just to find a mode of sustainable development, but also of sustainable knowledge” (Irwin 1995: 182).
Over the past decade, recognition of the complexity of many contemporary social and environmental problems and the limitations of disciplinary analysis has led to increased interest and support for approaches that provide more integrative and holistic analysis (Irwin 1995, Klein 1990). Traditional disciplinary approaches separate social and technical dimensions. In complex systems, these dimensions dynamically interact to constitute the whole. As the problems addressed in this thesis are shaped by issues and questions that cut across disciplinary boundaries, I chose to work from an interdisciplinary perspective. In this approach the social and technical can be brought together for a broader analysis of the issues.

This research was also exploratory. Issue identification, analysis of themes, and evaluation and integration of information were based upon review of relevant literature (government documents, academic, popular and alternative agriculture press) and narrative research. Relevant concepts and theoretical frameworks were drawn from a wide range of sources, including the applied agricultural sciences, agricultural extension, the sociology of agriculture, the sociology of science and technology, the political economy of agriculture, and social theory on knowledge and power. The narrative research consisted of in-depth semi-structured interviews, as well as conversations, observations and information from conferences, workshops and meetings.

1.4.2 Narrative Research: The Interviews

Narrative research focused on interviews with individuals from relevant sectors. I interviewed farmers, government policy analysts, extension representatives, agriculture scientists from both provincial and federal agricultural institutions, representatives from agribusiness firms involved in equipment and chemical manufacturing, and members of sustainable agriculture and farm organizations. Interviews were semi-structured with general outlines of topics and questions as a guide. Interviewees were encouraged, however, to speak freely on issues or subjects of relevance from their perspective.

With only a few exceptions, I conducted interviews in-person and in the place of work of those being interviewed, either on their farms, in their offices, or in their homes. I did this to make the interviews convenient and comfortable for those being interviewed and to give me an opportunity to
observe and experience the context within which people worked (and lived). By establishing personal contact and by using semi-structured interviews, I believe I established a degree of trust and obtained more detailed responses than would be possible through the use of more structured questionnaires. Although trust is difficult to measure, I believe that my gender, particularly as I was pregnant at the time, and outsider status, also conferred some advantages.

To conduct the interviews for this research, I travelled extensively in the southern half of Saskatchewan, an area of approximately 57,000 square kilometres. I carried out on-farm interviews in five week-long trips, averaging a thousand kilometres per trip. Interviews with provincial (the Saskatchewan Department of Agriculture and Food) and federal (Agriculture and Agri-Food Canada) government policy analysts and provincial extension personnel took place in Regina. Agriculture scientists from the College of Agriculture at the University of Saskatchewan and Agriculture and Agri-Food Canada were interviewed in Saskatoon and in Swift Current. Interviews were conducted in Saskatoon with representatives from corporations involved in agrochemical and farm equipment manufacturing and sales, or with an interest in alternative agricultural practices. I interviewed members of farmer and sustainable agriculture organizations in both rural and urban settings in Saskatchewan and at a workshop on sustainable agriculture in Bozeman, Montana.

Interviews ranged between two to five hours in length. Interviews with farmers were typically the longest as they often included tours of the farm and sharing a meal with the family. Many farmers were also interested in discussing other issues in agriculture relevant to them, such as marketing systems, commodity transportation options, and the effect of aboriginal land claim settlements on land prices and rural communities.

I recorded interviews by long hand. Initially, I experimented with tape recording interviews and with taking hand written notes, both of which were usually supplemented immediately after the interview or later that night with additional notes. I soon decided upon hand written notes as I felt some people were uncomfortable being taped and I did not find it difficult to write complete accounts.

Data from the farm interviews was entered into a database management program (PARADOX) for easy storage and retrieval. Both qualitative and quantitative methods were used to analyze data. In
order to maintain confidentiality and anonymity, I have presented the data in such a way as to avoid disclosing the source or distinguishing statements.

1.4.2.1 The Farm Interviews

The majority of the farm interviews were conducted on-farm in the spring and summer of 1995. These interviews were preceded by at least two telephone contacts during which the research was introduced, initial agreement to participate was obtained, scheduling of an interview was arranged, and directions to the farm were obtained. Fortunately, most directions were clear and detailed and I only got lost once. Typically, two to four interviews were conducted in a day, sometimes travelling a considerable distance between interviews. Days in the field were long and tiring. The first interview of the day usually began at 7am and the last finished at 10 or 11pm. I would read over and supplement notes in my room for the night.

Following a seven-month maternity leave (March 1996-October 1996), I conducted a small number of interviews and follow-ups to the in-person interviews by telephone in the winter of 1996 and spring of 1997. Although I preferred on-farm interviews, it was more convenient for me to complete the research by telephone during this time.

In developing outlines for the farmer interviews (see Appendix A), I referred to critical diffusion and adoption of innovation studies in which a number of interacting factors have been hypothesized to affect farmers’ attitudes, perception and adoption of alternative farming practices (e.g., Buttel and Swanson 1986; Lockeretz 1990; Nowak 1984, Roberts and Hollander 1997, Salamon et al. 1997). Many of these studies focus on the characteristics of the farmers (age, education, ethnicity, willingness to take risk, philosophy, value and goals) and the farming systems (biophysical conditions, tenure, labour, size of the farming operation, and type of operation). I incorporated these and other topics (for example, year of transition, commitment to an alternative farming practice, goals, involvement in agricultural and community organizations, views on sustainable agriculture and the future of farming in Saskatchewan) which I felt would provide useful information for understanding farmers’ decisions concerning their farming operation and their perceptions of sustainable agriculture.

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I selected farmers to interview from lists supplied by agencies that work with organic and zero tillage farmers. Names of organic farmers were provided to me by two organic certification agents with many years of experience working with organic producers in Saskatchewan. The Saskatchewan Soil Conservation Association (SSCA) provided me with names of farmers practising zero tillage, but not all the farmers identified were members of the SSCA. I asked these referral sources to identify farmers with the following criteria in mind: a serious interest and commitment to the alternative farming practice, such that at least part of the farming operation was converted; a range of years of experience with the practice (from transition to long-term involvement); and representation from each of the seven agricultural soil climatic zones in the southern part of the province (Henry and Harder 1991) (see Section 1.6.3). I considered it important to sample according to ecological zones, as “agriculture is a fundamental component of humans’ interrelations with ecosystems, therefore the need for an ecological perspective seems apparent” (Dunlap and Martin 1983: 201). There are a number of environmental variables in agricultural systems, including precipitation, temperature, length of growing season, topography, soil type and soil quality. According to Carter et al. (1994: 4), “in most inventories of agricultural systems, climate and soil type are major factors exerting an influence on the location and productivity of any farming operation”. Ashby and Coward (1980) state that even minor variations in agroclimatic conditions substantially affect farmers’ choices of farming practices.

I conducted interviews with individuals from 66 farming operations throughout the seven soil climatic zones: 33 of these operations were practicing zero tillage, and 33 were farming organically. The extent of conversion to a zero tillage system varied from farm to farm. In some cases it was practised on part of the farm operation while in others it was used throughout the entire farming system. All of the organic farms investigated had completed organic certification on all their crop land.

In developing the farm interview list I was not able to identify an equal number of farming operations for each of the soil climatic zones. In more marginal agriculture zones, such as the Dry Brown and Grey, there were fewer farmers practising these alternative approaches than in more productive zones, such as the Black and Moist Dark Brown.
While conducting the on-farm interviews I attempted to include spouses (or partners) and children involved in a farming enterprise whenever possible, but in the majority of cases interviews were conducted with the male ‘head of the household’. In some cases women were unable to take part in the interviews as they were engaged in off-farm employment, but other women who were present participated to varying degrees. In total, 70 male farmers and 13 female farmers took part in the interviews.

1.4.2.2 Interviews with Representatives from Other Constituencies

A total of 45 interviews were conducted with representatives from the other groups of actors identified as important to this study (government policy analysts, extension representatives, agriculture scientists from both provincial and federal agriculture institutions, agribusiness representatives involved in equipment and chemical manufacturing, farmer organizations, and sustainable agriculture activists). The guides I developed for these interviews (see Appendix A) were not based upon any particular studies, but more from general readings, observations and from the information and experience gained through interviews. Sampling was developed through a combination of purposive and snowball techniques in order to canvass a wide range of actors occupying strategic positions in different sectors.

1.4.3 Assessment of this Approach

The sample size of this study is limited for quantitative analysis, but is relatively large and rich for qualitative analysis. As samples were not randomly selected the results may not be considered representative of all organic or zero tillage farmers in Saskatchewan or elsewhere. Most of the farmers interviewed could be categorized as innovators and early adopters. Most had extensive general farming experience. However, given the total number of organic farms in Saskatchewan at the time of sampling (approximately 350), the sample studied here represents close to ten percent of the total population. As the total number of zero tillage farmers in the province was higher than the number of organic farmers in 1995, a smaller proportion of the total population is represented here.

This study provides important information on the similarities and differences between organic and zero tillage farmers within the soil-climatic zones of the province. This research serves as a set of
case studies to be compared with other case studies and provides a foundation for further farm-based research on alternative farming systems and sustainable agriculture in Saskatchewan.

1.5 The Prairie Ecosystem Study

This thesis is part of a larger interdisciplinary research project titled “The Sustainability of the Semi-Arid Prairie Ecosystem: Imperatives for Agriculture, Environment and Rural Communities” or more simply called the Prairie Ecosystem Study (PECOS). PECOS is one of the projects funded by the Eco-Research Program of Environment Canada’s Green Plan and administered by the Tri-Council Secretariat, which represents the Medical Research Council (MRC), the Natural Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC). Participants in PECOS included faculty and graduate students from the University of Saskatchewan and the University of Regina.

PECOS was initiated in response to the ‘rural crisis’ occurring in Western Canada, which is stemming from a number of environmental, social and economic problems (Anderson 1993). Governments have given considerable attention to the farm economic crisis and the effects of agricultural practices on environmental sustainability (e.g., soil erosion, the loss of biodiversity, the degradation and exhaustion of the soil, the eutrophication or pollution of waterways, and the reduction of wetlands and other wildlife habitat). According to Anderson, the rural crisis extends beyond economic and environmental concerns, to the social dimensions of family farms and rural communities.

There are increasing numbers of forced farm foreclosures, accelerated rural depopulation, increasing incidence of interpersonal and family violence, mental health problems, drug and alcohol abuse and rural crime, to name a few. These indicators of social disorganization are seen by many as threats to traditional rural lifestyles and forms of community (Anderson 1993:6).

In PECOS, the social as well as the economic and environmental issues facing rural Saskatchewan were examined through an interdisciplinary and community-based approach. The overall objective of PECOS was “to evaluate the sustainability of the semi-arid prairie ecosystems in terms of the health of the land and the well-being of the people and their communities, and to explore the prospects for a way of life that does not jeopardize these” (Anderson 1993:6). The project consisted of three separate
foci, reflecting the social, medical, physical and biological sciences. This thesis is primarily affiliated with Focus Group I, which identified determinants of agriculture practices and the links between these practices and community sustainability. Focus Group II assessed the potential health risks associated with environmentally occurring pesticides and toxic elements, and Focus Group III evaluated the health of the land and its biota.

In PECOS, the area of study is restricted to Saskatchewan Census region 3BN 3, part of the Palliser Triangle in the south-west part of the Province (Figure 1.1). This area was chosen because it contains a variety of landforms, soil types and land uses. It is also considered, overall, to be at the margins of viable agriculture and sensitive to environmental stress and therefore is representative of much of the semi-arid prairies in Western Canada and the United States. In this thesis I extended the area of study beyond that examined in other PECOS projects, to include representative zero tillage and organic farming systems from each the seven soil-climatic zones throughout the province. As was previously mentioned this was done to investigate the possible effects of these different biophysical factors on farmers' adoption of alternative farming practices and their perceptions about sustainable agriculture.

Figure 1.1 Location of Palliser's Triangle in the Canadian Prairie
1.6 The Context: A Profile of Agriculture in Saskatchewan

Throughout the history of agriculture in the province, independently owned and operated family farms have been the predominant type of production enterprise, however the numbers of traditional family farms continues to decline. In 1976, 92 percent of the farming enterprises in the Province were family farms, but by 1996, they represented 70.9 percent of the farming enterprises. Conversely, the number of farms operated as partnerships and as corporations has been increasing. Capital investment (land, equipment, building and livestock) and expenditures on other external inputs have risen on farms in Saskatchewan over the years, but commodity prices in domestic and international markets have not risen accordingly. As a result, average net farm income has been declining and an increasing number of farm families are relying upon off-farm income to supplement the income derived from farming. Off-farm employment figures for farm operators rose from 35 percent in 1991 to 44 percent in 1996 (Statistics Canada 1997). Despite these additions to farm household income, overall farm debt and farm bankruptcies have continued to increase. During the past two decades, farm debt in Saskatchewan has more than tripled, from 1,327 million dollars in 1974 to 4,757 million dollars in 1996 (Agriculture and Agri-Food Canada 1998). During the past 15 years, Saskatchewan has had the highest number of provincial farm bankruptcies in Canada (Agriculture and Agri-Food Canada 1998).

In 1991, for the first time in the history of the Canadian Census of Agriculture (which began in 1871), respondents could report more than one operator per farm household. This change made it possible for farm women and other family members to be statistically identified as contributors to farming operations. Of the 72,925 farm operators reported in 1996, 78 percent (58,315) were male and 22 percent (14,610) were female. In 58 percent of Saskatchewan farm households, the husband is listed as the sole farm operator. Less than 2 percent of the households listed women as the sole operators. Thirty percent of all the farm households listed both husband and wife as primary farm operators, and less than 5 percent listed children as additional operators. Households composed of lone individuals accounted for 10 percent of farm households, while Hutterite colonies represented less than 1 percent.

The average level of education for male farm operators is 11.1 years of schooling, but 20 percent have post secondary training, and 12 percent have some university education (Statistics Canada
The education level is somewhat higher for female farm operators, with an average of 12 years of schooling. Twenty-five percent have post secondary training, and 17 percent have some university education.

The farm population in Saskatchewan is ageing. From 1986 to 1996, the average age of farmers increased from 47.1 years of age to 49.3 years of age (Statistics Canada 1997). From 1991 to 1996, the number of farmers in the 35 to 54 category decreased by six percent, from 55 percent to 48 percent, while the number of farmers 55 years of age or older increased by seven percent, from 28 to 35 percent.

1.6.1 Socio-economic Trends

Agriculture in Saskatchewan is a relatively recent development. From the time of settlement (during the late 1800s and early 1900s) until the end of World War II, farms were predominantly small-scale, diversified, labour-intensive and local resource-based. Over the past fifty years, changes in technologies and techniques have radically transformed farming operations and the rural landscape. Most farms in the province are now large-scale, highly capitalized and mechanized operations specialized in either crop or livestock production. Farm size has been steadily increasing, from an average size of 369 acres in 1921 to 1,152 acres in 1996. Farms of 3000 acres or larger are becoming increasingly common throughout the province. The number of farms with gross receipts of $100,000 or more increased by 31 percent from 1991 to 1996, such that 25 percent of the farms in the province now generate 62 percent of the total farm income (Statistics Canada 1997). As farms have increased in size, the number of farms has steadily declined, from 138,713 in 1941 to 56,995 in 1996. The decline and restructuring occurring in the farming populations has also resulted in economic and social decline in many small villages and towns.

1.6.2 Characteristics of Crop and Livestock Production

Agriculture in Saskatchewan focuses on crop production. The major crops are wheat, canola, barley, hay and oats. Other crops include lentils, peas, flax, rye, sunflowers, mustard and horticultural crops. Large-scale grain farms predominate. Until recently wheat was by far the major crop, but long-
term depressed market prices for wheat have led to decreased production of this commodity and increased production of other grains, oilseeds and specialty crops.

A traditional crop/fallow system continues to be the most commonly used approach to crop production in Saskatchewan. In this cropping system, a field is left unseeded and in fallow or summerfallow every alternate year. Weeds are managed either by tillage, herbicides, or a combination of tillage and herbicide use. There is a trend, however, to more extended rotations and continuous cropping in the Province (Statistics Canada 1997). Summerfallowing is eliminated in continuous cropping systems. There is also a trend to less intensive and reduced tillage practices, collectively known as conservation tillage. In 1996, conservation tillage practices were used on 32.9 percent of the cropped land, an increase of 31.9 percent since 1990 (Statistics Canada 1997). Throughout the past decade, zero tillage or no-till has had the highest rate of adoption of all the conservation tillage methods used in Saskatchewan.

The changes that have taken place in cropping and field practices in the Province have led to increased use of fertilizers and pesticides. From 1981 to 1996, the proportion of crop land treated with fertilizers increased by 55 percent to 25 million acres or 53 percent of the provincial cropland; the area treated with herbicides increased by 49 percent to 27 million acres or 58 percent of the cropland; and the use of insecticides and fungicides increased by 41 percent to 3.6 million acres or 7.7 percent of the cropland in the province (Statistics Canada 1997). This increased use of agrochemicals is contrary to the overall trend occurring in Canada and throughout many industrialized nations, although application rates still tend to be relatively low in Saskatchewan. Despite the overall trend to higher use of agrochemicals, there is a small but growing number of farmers in Saskatchewan practising organic agriculture. This approach eliminates the use of synthetic agrochemicals and relies upon tillage, rotations and other cultural methods of pest control and soil improvement.

Livestock production is secondary to crop production in Saskatchewan but it is a significant and growing sector. Beef cattle are the primary focus in the industry, but other livestock are also represented, including hogs, poultry, dairy cattle, sheep, buffalo, elk, ostriches and llamas. Overall, traditional livestock production (beef and dairy cattle, hogs, poultry, and sheep) has decreased over the past fifty years and has become more concentrated in a smaller number of large operations (Statistics Canada
Few farmers now raise livestock for personal consumption or local sales. Agricultural products grown in Saskatchewan, whether crop or livestock, are primarily destined for export markets. In recent years there has been more development of processing and marketing in both crop and livestock sectors.

1.6.3 The Relationship between Soil Climatic Zones and Farming Practices

Soil and climatic conditions are the major biophysical factors determining agricultural potential, cropping patterns and the suitability of various farming practices in Saskatchewan (Henry and Harder 1991). Climatic conditions confine agriculture production in Saskatchewan to the southern half of the province, which extends from the edge of the boreal forest in the north to the United States border (49 N) in the south. The climate of this Saskatchewan Plain Region is semi-arid, with a relatively short growing season (average of 100 frost-free days) and harsh winters, and this has had a strong influence on the distribution of soils (Anderson and Van Kooten 1989). Because this relatively dry and cool climate creates marginal conditions for agricultural production, and because the year to year variability in climatic conditions is unpredictable, farming in this region is associated with a high degree of risk.

Soil surveys of the agricultural region in Saskatchewan have identified different soil zones. They range from the Brown soil zones in the most southern part of the province, to the Black soil zones in the central prairie, to the Grey soil zone in the north (Mitchell et al. 1944). Using information from these soil surveys and other climatic data, Henry and Harder (1991) have identified seven soil climatic zones (SCZ) in the southern part of the province: Dry Brown, Brown, Dark Brown, Moist Dark Brown, Black, Moist Black, and Grey (Figure 1.2). A SCZ is defined as a geographic area in which the soil forming processes are affected by a similar climatic (temperature and precipitation) environment. The following description of the soil climatic zones is adapted from Henry and Harder (1991), with additional information on soil zones from the Faculty of Agricultural and Food Sciences, University of Manitoba (1994) and Campbell et al. (1990).
Figure 1.2 Soil Climatic Zones of Southern Saskatchewan

A combination of low precipitation (300 to 350 millimeters) and high evaporation causes the Moist Dark Brown, Dark Brown, Brown and Dry Brown SCZs to be the driest (in ascending order) in
Saskatchewan. Total biomass per unit area and cropping options are limited by moisture availability. The majority of rangeland (short-grass prairie) is located in this area. Cereals are the major annual crops, although in recent years there has been an increase in pulses suited to drier conditions. The diversity and length of rotations tend to increase with increasing moisture availability, from the Dry Brown SCZ to the Moist Dark Brown SCZ. Although the incidence of summerfallowing is decreasing in these SCZs, it continues to be higher in these SCZs than in Black or Grey SCZs. From 1991 to 1996, there was also a significant increase in the amount of zero tillage and direct seeding reported in Brown SCZs. A number of factors may contribute to these trends. In the drier zones, summerfallowing continues to be viewed favorably by some farmers for both economic (as a way to reduce production costs and risk) and agronomic reasons (as a way to conserve moisture, prevent erosion, and control pests and diseases). On the other hand, an increasing number of farmers (with the necessary capital resources to make the transition) are adopting conservation tillage practices to prevent erosion, retain soil moisture, and to be able to farm larger acreages in less time.

The Black, Moist Black and Grey SCZs are the more moist (in ascending order) zones of the Province, receiving between 400 and 500 millimeters of precipitation and having lower evapotranspiration than the Brown SCZs. Relatively high levels of biomass can be produced in this region. Due to the higher moisture levels, a number of cropping options are available, including cereals, oilseeds and pulse crops. Wheat was the predominant crop in the past and is still a major crop, but barley and canola are now also major crops. The incidence of summerfallowing in these SCZs is significantly lower than in the Brown SCZs and the adoption of zero tillage and other conservation tillage practices is also lower than in the drier SCZs. Continuous cropping is widely practised in the Moist Black SCZ and to a slightly lesser extent in the Black SCZ. The Grey SCZ has the least moisture deficiency of any area in Saskatchewan, but length of frost free period is the major limitation to agricultural production in this zone. The low percentages of fallowing, conservation and zero tillage in this SCZ relative to Brown SCZs may be attributed to higher moisture levels and greater pest and disease problems than in the Brown SCZs.
1.7 Outline of This Thesis

The remainder of this dissertation is divided into six chapters. A broad analysis of the conventional and dominant approach to agricultural production in Saskatchewan is presented in Chapter Two. I begin by examining the factors that have influenced the adoption of an industrial model of development and then analyze how this model has shaped the social relations of production and the evolution of farming practices. This chapter concludes with an overview of problems associated with this model of agricultural development. Responses to these problems and the challenge of sustainable agriculture are investigated in Chapter Three. The general concept of sustainability and the controversy surrounding it are examined, as are the official/dominant and oppositional/alternative discourses on sustainable agriculture. Analysis of the official discourse focuses on how government policies and programs, agriculture science and agribusiness have selected and shaped zero tillage as part of the dominant model for sustainable production. In the analysis of the alternative discourse, I look at organic farming as part of the model that is being advanced by a large part of the sustainable agriculture movement. In Chapters Four, Five and Six I focus on local constructions of organic farming, zero tillage, and sustainable agriculture developed by farmers in Saskatchewan. The data gathered during the farm interviews are presented and analyzed in these chapters. Chapter Four focuses on the characteristics of the farmers and farming systems. In Chapter Five I explore the ideologies that motivate and shape farm management decisions and farmers’ perceptions of sustainable agriculture. In light of the research findings and the analysis developed in Chapters Four and Five, in Chapter Six I evaluate the practical and theoretical aspects of these farming systems as local responses to sustainability. In the final chapter, the dynamic nature of knowledge and power in agricultural systems is further investigated by examining some of the recent developments taking place within the global food system and how these current trajectories of change are impacting on zero tillage and organic farming systems in Saskatchewan. Conclusions drawn from this study are presented at the end of Chapter Seven.
CHAPTER 2: THE CONVENTIONAL MODEL OF AGRICULTURAL DEVELOPMENT IN SASKATCHEWAN

2.1 Introduction

The changes that have taken place in Saskatchewan agriculture over the past one hundred years reflect a productivist orientation and the implementation of an industrial model of development. The rationale for taking this approach has been to improve the efficiency of farm-level production of certain commodities, through scientific and technological advances, so as to be competitive in international markets.

In this chapter I examine the biophysical, socio-economic and political factors that have influenced the adoption and evolution of the model of agricultural development prevalent in Saskatchewan. I also look at the broad patterns of change that have taken place in farming practice and in the social relations of production—among farmers, the state, agricultural institutions, and corporate agribusinesses—within the context of this dominant model. In the final section of this chapter, I discuss environmental, economic and social problems that have arisen in Saskatchewan as a result of this approach to agricultural development.

2.2 The Influence of Biophysical, Macroeconomic and Institutional Factors

Saskatchewan is centrally located in the Canadian Prairies. Just over a hundred years ago, most of the land in this region was still part of the native prairie ecosystem that evolved over thousands of years and was inhabited by nomadic hunting and gathering peoples. Agricultural settlement of this area during the late 1800s is analyzed by Vernon Fowke (1957) and Jeffery Taylor (1994) as part of a nation-building strategy, as well as a project shaped by European territorial expansionism. During the mid-1800s, faced with limited resources and a growing market demand for grains (particularly wheat), Europe looked to the frontiers of Canada, the United States, Argentina and Australia for potential agriculture
development. Improvements in water and land transportation facilitated agriculture settlement in these countries and the formation of a global grain trade. Although the climatic conditions of the Canadian Prairie (a short growing season, severe winters, and semi-arid climate) presented challenges and limitations, it represented a large undeveloped territory with the potential for grain production. Agricultural settlement of this area was also seen to be of benefit to the urban and industrial core in Canada. It would be a cheap source of food staples and would expand the domestic market for eastern manufactured goods. Extension of the Dominion of Canada from east to west was also identified as a way to force a conclusion to the political challenge presented by the First Nations and Metis peoples on the prairies, and as a way to prevent American expansion northward. From the beginning then, the development of agriculture in Saskatchewan was strongly influenced by the economic and political interests of industrial capitalism and the State.

Within a short period of time, the vision of an export-oriented agriculture became a reality on the prairies (Taylor 1994). An extensive infrastructure was put in place, including communication, transportation and marketing systems. Settlers began arriving in Saskatchewan following the establishment of a homestead policy, the Dominion Lands Act of 1872, and an aggressive advertising campaign abroad (Morton and Martin 1938). By 1901 there were 13,500 farms, which increased to 95,000 farms in 1911 and peaked at 138,713 farms in 1936 (Statistics Canada 1994). In this early period of agricultural development, farms were mostly small-scale, family-owned, labour intensive and local resource-based (Murchie et al. 1936). Mixed farms with diversified crop and livestock production were predominant. These diversified, low external input farming systems enabled farm families to achieve a degree of household self-sufficiency, but they were still dependent upon capitalist enterprises for the sale of commodities in domestic and international markets and the purchase of manufactured goods. Industrial inputs for agriculture first became available during the late 1800s and early 1900s, when agribusinesses began to apply scientific and technological advances in chemical and electrical processes to agriculture (Taylor 1994). By the 1920s tractors were becoming common in Saskatchewan, but the use of synthetic pesticides and fertilizers was not prevalent until the 1950s and 1960s (Campbell et al. 1990).
By the early 1900s the state had established provincial and federal institutions for the production and transmission of agricultural knowledge in Saskatchewan (Anstey 1986, Fairbairn 1990). Federal experimental farms were instituted in 1886 and the University of Saskatchewan established a College of Agriculture in Saskatoon in 1910. Prior to the development of this formalized and professional knowledge system, a largely informal knowledge system existed in rural Saskatchewan, consisting of farmers, voluntary agricultural societies and farmer institutes (Fairbairn 1990, Taylor 1994). Until World War II this rural network continued to play a visible and prominent role in Saskatchewan agriculture, as government agencies fostered a collaborative relationship in research and extension (Anstey 1986, Fairbairn 1990, Taylor 1994). Problems in agronomy and animal husbandry were investigated by farmers and scientists, both on-farm and at designated research sites. Farmer institutes and agricultural societies continued to be an important vehicle for dispersing information throughout the farming community.

Fairbairn (1990) contends that this working arrangement kept the institutions more responsive to the wide ranging interests and needs of rural communities. Beginning in the 1920s, however, changes occurred within agricultural institutions resulting in the replacement of a relatively collaborative and integrative approach to agricultural research and extension with one that was more professional, hierarchial and specialized (Fairbairn 1990; Friedland 1991, Taylor 1994).

Agriculture, along with other academic fields, began to be divided into a greater number of specialized disciplines during the early 1900s. Friedland comments that as a result of these divisions academic analysis was “directed away from the social relations in agriculture to a focus on productivity” (Friedland 1991: 10). This emphasis was particularly obvious in the Canadian agricultural institutions. A range of applied sciences were included, focusing on various biophysical aspects of production, but representation of the social sciences was generally limited to Agricultural Economics, in which prevailing neoclassical theory supported the productivity model. Rural Sociology and Agricultural Journalism were also included in American agricultural institutions. Friedland maintains that dominance of the productivist approach inhibited critical discourse within these disciplines in the United States for several decades. Taylor (1994) adds that challenges to the productivist model were further inhibited by the formation of economic and political ties between the newly established agricultural institutions and the rising
agribusiness sector. He contends that the merging and focusing of institutional and industrial resources on productivist and capitalist goals was becoming increasingly common throughout North America in the early 1900s. As a result of the growing belief that "progress" in agriculture was necessary for economic and social well-being, there has been little room within the institutions for critical evaluation of this model of development (e.g., Berry 1977, Friedland 1991, Kloppenburg 1992, Rowe 1990).

The professional and specialized approach to knowledge that was adopted within agricultural institutions had an impact on the way in which farmers and farming practice were perceived within these institutions. Bennett comments that the "accelerated academization of agriculture led to the belief that the expert knew more than the farmer, and thus information should flow from the expert to the practitioner" (Bennett 1982:367). As a result of this hierarchial perspective, the diffusion-adoption or technology transfer model of knowledge generation and dissemination was developed. In this model, knowledge, produced by scientists within centralized institutions, is transferred by government extension agencies to the farming community (Rogers 1983). Farmers are seen as recipients of this expert knowledge and farming is viewed as a technical exercise in production that can be modified and improved through scientific and technological innovations. This model was implemented extensively in industrialized countries after World War II. In the post-war period, belief in scientific and technological progress deepened and the modernization of agriculture was seen as an essential component of revitalizing the economy. It has remained the dominant model in Saskatchewan since that time, placing institutions of agriculture science in a powerful and authoritative position in the development and promotion of changes in farming.

State agricultural policies have also had an influence on the type of agriculture that has developed in Saskatchewan (Fulton et al. 1989). Initial policies, such as those concerning homesteading, transportation and marketing established the infrastructure for agriculture on the Prairie. Other policies and acts implemented later, such as Crop Insurance and the Western Grain Stabilization Act, provided additional institutional support for grain production to compensate for production risk in this climate and fluctuating global markets. Agricultural policies came under critical examination following the collapse of global markets and pro-longed drought on the Prairies during the 1980s. There were calls for changes in
policy and programs that would encourage diversification in crop and livestock production and the
development of secondary industries (Fulton et al. 1989; Van Kooten 1993).

The Government’s position on agriculture has changed significantly during the present decade. There has been a rapid and progressive withdrawal of interventionist policies and programs that supported the Prairie wheat economy. A variety of factors have influenced these changes in government agricultural policy including Canada’s involvement in the North American Free Trade Agreement (NAFTA) and the General Agreement on Tariffs and Trade (GATT), the reduced importance of wheat exports to the Canadian economy, a fiscal crisis at the federal and provincial levels, and the recognition of the need to address persistent environmental problems associated with conventional approaches to grain production (Drache and Gertler 1991, Gray et al. 1995, Hall 1998, Winson 1993). As a result of these changes, farmers are forced to alter production practices to meet new economic and environmental goals, in a context of reduced government support and more liberalized markets (Gray et al. 1995). The role of the nation-state in shaping agriculture development is diminishing with the development of freer trade arrangements (Hart 1995, Juillet et al. 1997). Global markets and transnational agribusiness corporations are now the most important players affecting change (Hart 1995, Juillet et al. 1997, Heffernan and Constance 1994).

Increased use of capital inputs since World War II has resulted in parallel growth and expansion of the agribusiness sector, from the production of inputs to processing and marketing (Goodman and Redclift 1991, Lind 1995, McMichael 1998, Winson 1993). In recent decades, consolidations have resulted in the formation of a small number of powerful, multisectoral, transnational agribusiness corporations. The extent of global corporate involvement and control has resulted in major restructuring (Bonanno et al. 1994, Heffernan and Constance 1994, Goodman and Redclift 1991, Murdoch et al. 1994, Winson 1993). A global agri-food system has been created in which there is freer movement of agricultural products, technology, and capital across state borders. The major economic incentives driving the liberalization of agricultural trade are greater flexibility, productivity and profits (Magdoff et al. 1998).
As scientific advances have facilitated the application of an industrial approach to production, ties between agricultural institutions and agribusiness corporations have strengthened in Saskatchewan and throughout Canada, particularly during the 1990s (Clark 1999, Clark et al. 1996, Faller 1998, Hall 1998). During this time, both federal and provincial levels of government have reduced conventional forms of spending in the agricultural sector, and have actively sought ways to partner with the private sector to assist in the development of new knowledge-based production technologies. Industry and the state have identified these technologies as solutions to many of the problems and challenges facing agriculture. Some scientists have publicly criticized this trend as the progressive re-positioning of agricultural institutions, from serving “the common good” to serving the interests of corporate capitalism (Clark 1999). Clark, an agricultural scientist at the University of Guelph, maintains that this raises ethical concerns and is a contravention of the social contract between these institutions and society. Faller’s (1998) study of the impact of the science-industry alliance on farmers and farm work in Saskatchewan supports Clark’s critique. According to Faller, public agricultural institutions involved in education, research and extension have become a “key mechanism for promoting the interests of private corporations by not only providing the infrastructure and technical resources, but also by profoundly legitimizing both the ideology of science as true knowledge and progress on the one hand, and the sanction of a public institution on the other” (Faller 1998: 12). Faller, Clark and others (e.g., Berry 1977. Hall 1998, Hightower 1973, Kloppenburg 1991, Rowe 1990) contend that as a result of the hegemony of the scientific/industrial approach, farmers’ knowledge and skills are being degraded and displaced as production is increasingly defined and driven by externally developed technologies and techniques.

1. In 1993 Agriculture Canada established the Matching Investment Initiative (MII) which guarantees that the government will match funding that agribusinesses or commodity groups are willing to invest for applied research projects. Due to the private sector’s keen interest in this program, Agriculture Canada has increased resources for this partnership program and decreased the resources directed at public good research. The ratio of public good research versus applied or industry related research has changed from 70:30 to 50:50.
2.3 Struggle and Conflict at the Point of Production: The Social Relations of Production

"Knowledge is central in agriculture," says Taylor (1994:15), "and it is contested ground." Taylor identifies knowledge as both a material and ideological force over which there is struggle and conflict at the "point of production."

Antagonisms in production are more than struggles over control of knowledge as a material force. They also represent struggles over the production of knowledge itself, or the constitution of meaning (identity and ideology)....One’s class and gender identities are anchored in this struggle, forming one’s sense of place in and perception of production, and ultimately framing one’s understanding of all social reality (Taylor 1994: 16).

In agricultural systems, farmers struggle to develop appropriate production and labour processes that will enable them to retain sufficient capital and resources within the family enterprise for the maintenance of their unique identity and way of life. Corporate capitalists, on the other hand, seek opportunities to substitute industrial products and processes for local knowledge, skills and labour. With increased reliance on purchased inputs, corporations are able to achieve greater control over production and profits. According to Taylor, the struggle between agrarian and industrial sectors is a highly variable historical process that has taken many different forms in different settings.

In Saskatchewan, independently owned and operated family farms continue to dominate in the realm of primary production. Family farm enterprises are typically dependent on capitalist markets for the sale of commodities and the purchase of inputs other than labour (Friedmann 1978, Taylor 1994). Members of the family unit normally supply labour, although it may be supplemented with hired help. Farmers retain a degree of control over production as they make their own farm management decisions. The internal organization of the farm firm/household is non-capitalist, but is strongly tied to markets, and strongly influenced by state policies and public agricultural institutions.

The transformation of crop production systems into corporate owned, hired labour-based industrial enterprises has been limited in Saskatchewan.² Instead, agribusinesses have more aggressively pursued what Goodman and Redclift (1985) identify as “partial appropriation” of production. According

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² The number of crop production enterprises operated as corporations has been increasing in Saskatchewan, but there are still relatively few and most are owned and operated by family members with some additional hired labour (Statistics Canada 1997). A more extreme example of corporate cropping systems can be found in the fruit and vegetable regions of southern California, where both management and labour positions are hired. A significant corporate trend is occurring in Saskatchewan agriculture, however, in the area of
to Goodman and Redclift, this is achieved by creating "sites of valorization" for a maximum number of capitalized products and processes (e.g., hybrid and genetically engineered seed, agrochemicals and biological control agents, machinery and equipment, buildings and storage facilities, and remote sensing technology). Once a 'site of valorization' is established, profits are then optimized by increasing the complexity and cost of the inputs.

Over the past one hundred years, farmers in Saskatchewan have frequently called upon the democratic state to play a mediating role in their conflict with industrial capitalism. In the past, governments and agricultural institutions have intervened more actively. However, in the context of liberalized trade agreements and the rising power of transnational corporations, the role of the state as mediator or regulator has been weakened. Nettie Wiebe (farmer, past president of the Canadian National Farmers Union, and current member of the faculty at the University of Saskatchewan) argues that as a result of the increased commitment to agricultural commoditization and "free" trade, there is no longer an overall policy framework in Canada that supports the preservation of family farms and rural communities (Wiebe 1998). Faller supports this assessment. He adds that these changes are being made in order to "advance the interests of corporate capitalism, to maintain the reproduction of prevailing capitalist accumulation strategies that generate the bulk of the state's revenue" (Faller 1998: 8).

Governments at all levels are constrained by their commitment to capitalist growth and accumulation. Concerns have been raised about the survival of the family farm and the overall future configuration of agriculture (e.g., Atkinson 1988; Lind 1995, National Farmers Union 1990, Wiebe 1998).

Classic debates on the 'agrarian question' examine the persistence of family enterprises in advanced capitalist economies and how specific economic and ecological conditions present obstacles to direct capitalist involvement (e.g., Chayanov 1986 (1924), Friedmann 1978, Kautsky 1898 (1899), Mann and Dickinson 1978). Persistence of the family farm in Saskatchewan is linked to the high degree of risk associated with crop production in this locale (Bennett 1982). The dependence upon biophysical factors for reproduction of capital and the unpredictability of climatic conditions, the limited number of crops that can be grown, as well as the volatility of global markets, create a level of risk that has inhibited

intensive large-scale livestock operations.
corporate take-over of production enterprises. Farmers, on the other hand, are willing to farm in spite of the risk due to what economists identify as non-rational economic behavior, as opposed to rational profit making behavior (Friedmann 1978). Certain non-capitalized aspects of the work and the lifestyle, such as freedom and autonomy in the workplace, the absence of division between the home and the workplace, the complexity and diversity of the work required, features of rural communities, tradition and culture, and the closeness with nature, are some of the factors that motivate certain people to farm (Berry 1977, Strange 1988). Farmers in Saskatchewan and elsewhere employ a variety of strategies, in both labour and production processes, to deal with the risk of farming (Bennett, 1982, Friedmann 1978, Long and Villareal 1994, Stirling and Diaz 1989). For example, the involvement of family members in the labour process reduces operating costs, increases flexibility, and socializes children into farming (Friedmann 1978). Diaz and Stirling (1989) identify the strategies farmers employ to deal with the risk of farming and to maintain their “way of life” as their “rationality of reproduction”.

A number of different micro-level factors (e.g., age, education, personal ideology, religion, access to information, skill level, economic factors, labour availability, tenure, biophysical conditions of the agroecosystem) and macro-level factors (e.g., scientific and technological advances, agricultural policies, markets) have been hypothesized to influence farmers’ decisions or strategies. Results from diffusion of innovation studies are, however, often variable and conflicting (e.g., Buttel and Swanson 1986, Lockeretz 1990, Roberts and Hollander 1997, Stonehouse 1994). In a comprehensive analysis of the many factors affecting farmers’ adoption of soil conservation practices, Stonehouse (1994) concludes that variation in farm-level factors, and the complex nature of the interactions of all factors intersecting at the farm-level, make it difficult to make general hypotheses or theories as to why farmers make certain decisions. Van der Ploeg (1992) agrees with this conclusion and does not find this complexity or variability problematic. He views the variation in micro- and macro-level factors operating at the farm-level, and the number of different strategies or responses available to farmers, as creating an important “room to manoeuvre”, which generates opportunities for a diversity or heterogeneity of farming styles.

3. Diffusion of innovation studies (Rogers 1983) empirically examine the influence of micro-level and macro-level factors on how farmers perceive and respond to risk associated with the adoption of new innovations.
and systems to emerge. He adds that scientists and extension agents using conventional approaches find it difficult to deal with the diversity that exists at the farm-level, therefore seek to simplify reality by grouping farming systems into a smaller number of categories. The significance of the heterogeneity of farming systems, van der Ploeg argues, is that it presents a variety of responses and potential solutions to current problems. Given the variability of local and external factors, there is no one right way to farm but rather a number of viable solutions.

In the dominant diffusion of innovations model, farmers are viewed as recipients and implementers of scientific and technological change (Rogers 1983). Early adopters are classified as progressive farmers, while late adopters or those who don't adopt new innovations are identified as unprogressive, or laggards. Van der Ploeg (1990) argues that this type of classification fails to accurately characterize the role of farmers and the complexity of their decisions and responses. Just as there have always been those that have accepted and benefited from scientific and technological advances, there have always been farmers involved in various forms of active resistance to change imposed externally. Those farmers who resist adjust their farming strategies, in a variety of ways, in order to decrease their reliance upon external inputs and institutions and achieve their own goals and objectives. Other farmers rely upon these external resources in order to achieve what they perceive to be the benefits of the dominant approach. Van der Ploeg contends that whichever position is taken – one of resistance or one of acceptance – farmers remain the central active strategists in local agroecosystems. He suggests we view farmers as principal actors in the organization of production, "rather than merely cogs in the wheels of change" (van der Ploeg 1990: ix).

Throughout the history of agriculture in Saskatchewan, farmers have protested and resisted exploitation and control by more powerful economic and political forces (Faller 1998, Holtslander 1998, Taylor 1994). Resistance can involve production, labour or marketing strategies that attempt to increase self-sufficiency and economic viability, thereby changing the material conditions of their existence. Examples of these strategies include: shared bulk buying, reduced use or elimination of agrochemicals; use of equipment and machinery of appropriate scale and cost, making do with older technology, inventing or modifying machinery, sharing equipment; collective marketing strategies; sharing labour and
expertise. Resistance also takes place on ideological ground and is linked to distrust of an agriculture establishment that has placed greater priority upon productivity and trade than upon people and community (e.g., National Farmers Union 1990, Wiebe 1998). Resistance, therefore, can be expressed in different ways and at different levels of organization – from production and labour decisions of individual farm households, to the collective actions of related and unrelated households working in formal or informal partnerships, and to the formation of farmer organizations and social movements that seek to influence the direction of change in agriculture.

2.4 Changes in Crop Production Practices

There have been a number of significant changes in crop production in Saskatchewan during the past one hundred years. These changes have included the development of high yielding crop varieties suited to Prairie conditions, improvements in machinery, equipment and agrochemicals, as well as other advances in farming techniques. Conventional cropping systems in Saskatchewan are characterized by large-scale grain production and extensive use of tillage, summerfallowing, synthetic fertilizers and pesticides. Although conventional approaches are still prevalent, over the past few decades the use of intensive tillage and summerfallowing has been declining, while the use of alternative production practices, such as conservation tillage and organic farming, has been increasing.

2.4.1 Tillage and Summerfallowing

Tillage has been a major component of farming practices in Saskatchewan since settlement. It is used for weed control, for integration of organic matter (crop residues) into the soil, and for seedbed preparation. Carter (1994) describes tillage as the principal action resulting in soil perturbation and subsequent modifications in soil structure.

From an ecological viewpoint, such perturbations strongly influence the distribution of energy-rich organic substances within the soil and thus impact on energy flow and the dynamics of soil geochemical cycles. However, tillage can also adversely affect soil structure and cause excessive breakdown of aggregates leading to a potential for soil movement via erosion. Thus, tillage is one system component that is easily subject to manipulation leading to either positive or negative consequences for agricultural sustainability (Carter 1994: 12).
Early tillage implements, such as the plow and disc harrows, were not suited to dry prairie conditions and resulted in severe soil erosion problems during the 1920s and 1930s. In the following few decades, a number of new technologies were developed by farmers and agriculture scientists to increase the amount of crop residue maintained on the soil surface, therefore decreasing the vulnerability to erosion (Anstey 1986). The first changes in tillage practice are referred to as stubble mulch or trash farming. All of the stubble mulch technologies utilize a blade type of implement to slice off weeds below the soil surface, leaving the surface relatively undisturbed (Anderson and van Kooten 1989). The first implement of this type was introduced to the region in 1936 by an Alberta farmer, C.S. Noble, and was called the Noble Blade (Anstey 1986). The rod-weeder is another tillage tool that uses a rotating rod pulled just below the surface to kill weeds. Both these tillage implements leave a high percentage of crop residues on the soil surface and are still recommended for use (Saskatchewan Agriculture and Food 1987).

During the 1950s and 1960s, farmers in Saskatchewan began using soil-incorporated herbicides for weed control and inorganic fertilizers to improve declining soil fertility. In order to achieve more effective use of these inputs, many farmers returned to more intensive tillage equipment (Lindwall et al. 1998). Other factors also played a role in farmers’ decisions to abandon stubble mulch technologies, including poor weed control under wet conditions and increased difficulty with seeding into soil with more trash cover. As a result of the increased use of intensive tillage, and the dry climatic conditions and lower yields of the late 1960s and early 1970s, soil erosion became a serious problem once again on the Prairies.

The practice of summerfallowing also has a long history in Saskatchewan and has been linked to soil erosion problems. This technique was adapted to Prairies conditions at the Indian Head Experimental Farm in the 1890s (Anstey 1986). Fallowing involves leaving a field unseeded for one growing season and keeping the land free of new vegetative growth. This is done to allow precipitation to accumulate in the soil, to accelerate the decomposition of crop residues resulting in nutrient release, as well as to provide an opportunity for weed and disease control (Anderson et al. 1990). The economic advantages of
summerfallowing include reduced need for agrochemical inputs, reduced risk of crop failure or poor yields, and reduced harvesting-related costs (Campbell et al. 1990).

A wheat/summerfallow cropping system has been common in Saskatchewan over the past five decades. Frequency of falling ranges from once every two years in the drier regions, to once every three to five years in moister regions. Tillage has been the traditional method used to keep fallowed land free of vegetation, with three to five tillage passes per crop season. The combination of frequent tillage and summerfallowing (where soils are not adequately protected by plant cover or crop residue) has, however, been identified as a major contributor to loss of organic matter content, soil erosion, deterioration of soil tilth, loss of nitrogen, and buildup of soil salinity (Boehm 1995, Rennie 1986, Larney et al. 1994). Some researchers (Anderson 1961, Biederbeck et al. 1984, Campbell et al. 1990) maintain that in many cases the degree of soil degradation arising from summerfallowing and tillage can be minimized or eliminated by appropriate selection of tillage implements, reduced frequency of tillage and summerfallowing, optimized timing of tillage, and development of appropriate rotations. Campbell et al. (1990) have suggested that summerfallowing may be necessary and economically efficient in the driest areas of the Prairie.

During the past thirty years, advances in agrochemicals and direct seeding and spraying equipment have led to significant increases in the use of conservation tillage practices and continuous cropping, while the use of summerfallowing and tillage has decreased. This trend has been accompanied by increased use of agrochemicals for pest and disease control, and for augmenting the nutrients available for crop development. Of the three Prairie provinces, Saskatchewan has been in the lead in adoption of these alternative farming practices and in the use of agrochemicals. In 1996, $510 million was spent on fertilizers and $366 million was spent on herbicides in the Province (Statistics Canada 1997).

2.4.2 The Use of Agrochemicals

The introduction of agrochemicals to crop production in Saskatchewan is relatively recent. Prior to 1960, the use of synthetic fertilizers was minimal due to the natural fertility of the prairie soil and extensive use of the crop/fallow rotation (Campbell et al. 1990). Since that time, the use of nitrogen and
phosphorus fertilizers for annual crop production has increased rapidly, partly as a result of more continuous cropping and partly due to the gradual removal of nutrients by crops and general soil degradation (Campbell et al. 1990).

The use of pesticides has been increasing in Saskatchewan since the early 1950s, when the herbicide 2,4-D was first introduced. Numerous other pesticides have been used in Prairie agriculture during the past five decades, but documentation of the use of particular pesticides is not available as the Census of Agriculture has not included this type of data and agribusiness firms involved in development and sales are reluctant to release such information (F.A. Holm, personal communication). According to Faller (1998: 44), "chemical manufacturers tightly control the knowledge related to the development of agrochemicals."

The extent of this control is underlined by the universal practice of chemical companies to refer to brand names and avoid reference to the scientific names. The brand names are typically action-oriented words which demonstrate to farmers their dominance over nature (the weeds) and the success they will enjoy from using the chemicals...Advertisements appeal directly to presumed male aggressiveness and to assumed innate fears. Examples of television advertisements for farm chemicals include: "Wanted" posters of weeds put up on a board, old west style, to be blasted with a shotgun (the chemical) in the hands of the virtuous upholders of their rights (farmers); a sophisticated electronic visual device (the vigilant farmer), like the sights of a Star Wars weapon, descends to ground level in a grain field to search out weeds, then vaporizes them with a laser beam (the chemical)......; weeds are portrayed as a pack of wolves, snarling viciously at the camera, to be hunted down with the aid of modern science (the chemical), leaving the farmer feeling safe and protected. The chemical formulations, their biological effect on weeds, and the environmental impact of their use are not discussed. The gulf between knowledge of chemicals and executing farm tasks related to chemical use is enormous (Faller 1998: 44-45).

Based upon a survey of twenty-five producers in Saskatchewan, Faller reported that "none of the farmers identified any working knowledge about the scientific origins and chemical action of the products they used" (Faller 1998: 44). Farmers were knowledgeable about the practical application of agrochemicals, such as how to identify weeds, what chemical to use with certain crops, rates and recommended application methods. Most of this information had been obtained from pamphlets and meetings hosted by chemical retailers and companies, as well as from government and university extension services. Farmers have also had to develop knowledge of appropriate herbicide rotation as problems of weed resistance have increased.
Concern about the effects of agrochemical use on environmental and human health has been increasing since the 1960s. Some early pesticides used (e.g. DDT, a chlorinated hydrocarbon) were found to have detrimental effects on the environment and on human health, and were banned in industrialized/developed countries, although some are still used in developing countries (Pimental et al. 1992). More recently developed pesticides, including biological control agents, are reported to have lower residual and more targeted effects, but there are still many herbicides in use with long residual environmental effects (F.A. Holm, personal communication). The long-term effects of low-level exposure to agrochemicals and the multiple contaminant effect have not been extensively researched. Studies conducted at the Center for Agriculture Medicine in Saskatchewan and elsewhere are indicating that farmers have a higher incidence of several types of cancers, such as non-Hodgkin’s lymphoma, prostate, brain, leukemia, and multiple myeloma, and there appears to be an association with exposure to certain agrochemicals currently in widespread use (Hardell and Eriksson 1999, McDuffie et al. 1995).

2.4.3 Rotations

Crop rotation refers to the different crops grown in recurring succession on the same land. Until the 1950s crop rotations played a key role in Prairie farming practices and were an important area of scientific research. But with the introduction of relatively inexpensive synthetic nitrogen fertilizer and other agrochemicals, and increasing market demand and institutional support for a limited number of commodities, interest in the development and use of diversified rotations by farmers and researchers decreased dramatically (Francis and Clegg 1990). Clancy et al. (1993:8) comment that although “both history and science have shown that rotation is beneficial to soil and long-term crop productivity,” it has been the single most neglected cultural practice in modern agriculture. The benefits of crop rotation include: maintaining and building soil fertility; reducing soil erosion; reducing build up of disease, insect, and weed pests; speeding the farm workload; reducing vulnerability to weather and fluctuating markets; and decrease reliance on the use of agrochemicals for fertility, weed and pest and disease control.
Traditionally, developing a rotation meant selecting a combination of crops for their ability to establish mutually supportive physical, chemical and biological relationships with the soil. By integrating an appropriate crop rotation (including the use of competitive or “smother” crops, and legumes and grasses to add nitrogen and improve soil quality overall) and with the use of tillage, farmers could control weeds, insects and diseases and build soil fertility (Francis and Clegg 1990). With the introduction of agrochemicals, the meaning of crop rotation changed in most conventional agricultural systems, to indicate that the same crop is not grown for two years in succession (e.g. the wheat-fallow rotation in Saskatchewan). Over the past decade, however, there has been renewed interest in more complex rotations (including other grains, oilseeds and pulses) due to depressed wheat prices, the elimination of government support policies and programs, increasing costs of agrochemicals, and greater awareness of environmental problems associated with conventional production. Most farmers, however, lack the knowledge and experience of working with complex crop rotations. In a recent investigation of continuous cropping in the PECOS study area of southwestern Saskatchewan, Mickleborough (1997) showed that farmers lacked information on crop rotations generally and on their economic and production benefits (yield and income gains) specifically. Clancy et al. (1993) comment that organic farmers are some of the best sources of knowledge about crop rotations, as they rely exclusively upon cultural means to provide fertility and pest control.

2.5 Challenges and Contradictions Confronting Agriculture in Saskatchewan

The application of scientific and industrial advances has increased productivity in Prairie agriculture, but this progress has been accompanied by several ecological and socio-economic consequences. Some of these consequences remain local or regional in effect, but the industrialization of agriculture worldwide has resulted in some significant global impacts as well.

2.5.1 Environmental Problems

The cultivation of ecosystems for intensive agriculture production is the most significant human alteration to the ecosphere (Matson et. al. 1997). The Canadian Prairie represents one of the world’s most
highly altered ecosystems. Only a small percentage of the original native prairie remains in Saskatchewan. This transformation of the landscape has meant a significant loss of biodiversity, as populations of many native plants and animals have been affected, some to the point of endangerment, extirpation and even extinction. Most studies of the impact of farming on the environment, however, relate to the economic productivity of the prairie landscape, namely the effects on soil and water resources.

Soil is a critical resource for farming because it provides nutrients and moisture for crops as well as a growing environment for both the crops and the communities of soil microorganisms that recycle nutrients and play a role in plant disease resistance. The relationship among soil, plants and climatic conditions is highly complex and interdependent, and although there have been many attempts to define soil quality in terms of its productive capacity, there is still no single measure (Acton and Gregorich 1995). Soil quality is estimated by measuring specific properties, such as organic matter content, structure and erodibility. Measurement and assessment is difficult, as there are many factors that affect these properties, and soils are dynamic and variable over time. A soil quality index is being developed in Canada that will attempt to identify appropriate indicators and more reliable methods for measuring them (Acton and Gregorich 1995).

Since the early days of farming on the prairies, soil degradation has been the major focus of investigations concerning the effect of agriculture on the environment (Acton and Gregorich 1995, Anderson et. al. 1990). In Saskatchewan, the main problems have been wind and water erosion and subsequent loss of topsoil, the layer most supportive of plant, animal and microbial life. Loss of topsoil is often equated with loss of soil organic matter, which is critical as it provides a store of nutrients and is important for maintaining soil structure and water holding capacity, and for resisting erosion. The extreme erosion of the 1930s, due to a prolonged drought and unsuitable farming practices, resulted in a significant loss of soil organic matter from the original prairie soil. Since that time, soil organic matter and soil quality have continued to decline, but at a slower rate. Although changes have been made to farming practices, many conventional production methods, including intensive tillage practices, fallowing,
monocropping, and large open fields with minimal use of windbreaks, can have a negative effect on soil structure and soil fertility.

Contamination of surface and groundwaters from agricultural activities has also long been a concern in the region. This concern has intensified with increased use of synthetic fertilizers and pesticides (Anderson et al. 1990). Although application rates for agrochemicals are higher in other parts of Canada, more than 80% of all the herbicides used in Canada are applied to the large agricultural area on the Prairies (Science Council of Canada 1992). Reynolds et al. (1995) consider the low-level, non-point agrochemical contamination of the Prairie to be a significant risk because of its extent and the difficulty in controlling it. The widespread use of agrochemicals on the Prairie and elsewhere is also a threat to more distant ecosystems. Biomonitoting of Arctic pollution has revealed that agrochemical chlorinated hydrocarbon contaminants are being transported to the Arctic via air currents, where they are severely impacting on the health of polar bears (Norstrom et al. 1998).

As reliance on pesticides has intensified globally, there is concern about the increasing appearance of genetic resistance in weeds and pests (Morrison and Devine 1993, Moss and Rubin 1993). Industrial agriculture has contributed to significant losses in biological diversity. The use of pesticides negatively affects many non-target plant, animal and microbial species (Pimental et al. 1992, Matson et al. 1997). The reliance upon a reduced genetic resource base in agriculture influences the composition and abundance of the associated biota which interact with and effect soil and plant processes (Science Council of Canada 1992).

The impact of agriculture on global climate change is also a concern. Methane, nitrous oxide and carbon dioxide are by-products of agricultural crop and livestock systems. The production of these greenhouse gases from agricultural sources is estimated to account for ten percent of Canada's total emission of greenhouse gases. These gases are implicated in major changes in global weather patterns (Matson et al. 1997). The agricultural production of greenhouse gases is likely to continue to increase in Saskatchewan due to increased mechanization, long distance transport of agricultural commodities, expanded use of agrochemicals and other manufactured inputs, and more intensive livestock operations.
2.5.2 Socio-economic Problems

Economic gain has been the greatest factor in determining the relationship to the land in Saskatchewan. Yet, increased productivity, and expansion of the processing and marketing sectors worldwide has generally kept grain prices low relative to the cost of production (Fulton et al. 1989, Winson 1993). Farm support programs were developed to compensate for this cost-price squeeze, but these programs effectively institutionalized over-production and increased the capitalization of farming (Hall 1997). Despite state subsidization in Canadian agriculture there have been recurring financial crises, resulting in increasing farm debt, dependence upon off-farm income, and bankruptcy (Fulton et al. 1989).

Agriculture in Saskatchewan is also associated with a high degree of risk for the health of farmers. Farming now has the highest occupational risk of accidental death and disabling injury (Gerberich 1995). Increased mechanization has resulted in a declining number of experienced farm labourers. Farmers either over extend themselves to compensate for labour shortages or rely on inexperienced labour, usually women and children family members. There is growing evidence of other health risks for farmers and their families associated with the use of agrochemicals including, certain cancers, neurological problems and adverse reproductive conditions (McDuffie et al. 1995). In the PECOS study, Abaidoo (1997), MacFarlane (1997) and Stewart (1997) reported a growing uneasiness among farm operators and their families with regard to the use of pesticides in farming.

Increased dependence on scientific and industrial inputs has negatively impacted on farmers' knowledge and control over production, resulting in what Diaz and Stirling (1989) describe as the "deskilling" of farm labour. Many changes in production techniques and technologies are being developed externally. Farmers feel pressured to keep up with rapid technological change, which creates stress and contributes to a growing sense of powerlessness (Cornish and Gerard 1995, Lind 1995). Farmers are being told it is their social and moral responsibility to adopt new technologies that would generate environmental benefits, and would increase production output in order to feed a rapidly growing world population (Avery 1997; Molnar et al. 1992). Those farmers without access to the necessary capital, or those who are reluctant to accept the technological and industrial model of farming, are identified as non-progressive.
There are many sources of stress in farming, but farm debt is considered to be the major source (Cornish and Gerrard 1995). Financial stress can affect mental and emotional health, resulting in anxiety, depression, relationship problems, substance abuse, domestic violence, and suicide. To deal with shrinking margins, farmers are encouraged to borrow the capital needed to expand the scale and performance of production, and, or to take off-farm employment. Both these options elevate stress levels, which ultimately limit a farmer’s ability to make good management decisions.

The declining number of farms and rural communities in Saskatchewan has increased the distance between neighbours and contributed to a growing sense of isolation. Social networks are vital to several aspects of rural life including the personal, information and skill exchange, resource mobilization, and labour and equipment sharing (Gertler 1998). Institutional supports for farmers (rural health delivery, emergency response, schools, and family support services) have also been reduced.

In addition to the increased spatial distance between farms, Stirling and Conway (1988) argue that the political distance between farmers has also increased. The “disappearing middle” phenomena has resulted in the predominance of smaller, usually part-time farms, and larger, highly capitalized farms. The rural populations’ increased dispersion and differentiation reduces their ability to organize around issues affecting rural life. Currently, the organization of farmers is more common along commodity production and marketing lines, than along political or social issues. As the political autonomy of farmers declines, agriculture is increasingly being driven by forces external to the farm community (Murdoch et al. 1994, van der Ploeg 1990).

Many farmers feel betrayed by the government’s lack of support for the family farm. However, given that social reproduction of family farms and rural communities is getting more difficult, many of these same farmers discourage their children from farming. This is contributing to the trend of an ageing farming population (Statistics Canada 1997).

2.6 Summary

In this chapter I have briefly examined the way in which agriculture has evolved in Saskatchewan and the factors that have influenced this development. Important changes in technical and
social aspects of production have been identified and discussed. The central theme developed in this chapter is that knowledge is both a material and ideological force in agriculture. In the struggle over knowledge, the relationships between different actors (e.g., the state, agribusiness firms, farmers, consumers) continually evolve. The strengthening of ties between industry and institutions of agricultural science is identified as a major factor shaping the progressive\textsuperscript{4} industrialization of agriculture in Saskatchewan and the identity of simple commodity producers. Farmers' 'rationality of reproduction' and strategies for survival and resistance are examined. In the final section of this chapter, socio-economic and environmental consequences of this approach to agriculture are reviewed. Approaches to these problems and the challenge of sustainable agriculture are introduced in Chapter Three.

\textsuperscript{4} Progressive in this usage means advancing in severity, complexity and extent.
CHAPTER 3: THE MAKING OF SUSTAINABLE AGRICULTURE

3.1 Introduction

Over the past three decades there has been increasing recognition and analysis of environmental and socio-economic problems associated with contemporary approaches to growth and development. Although much of the attention has focused on environmental degradation, many would argue that there has been exploitation of human as well as ecological resources, resulting in increased economic disparity, and the loss of traditional cultures and indigenous knowledge systems (e.g. Allen 1993; Redclift 1987, 1993; Shiva 1999). These social and environmental problems have been discussed in a series of international forums (e.g., the 1972 United Nations conference on Human Settlement; the 1983 United Nations Committee on the Environment and the Economy; the 1992 Rio Earth Summit; and the 1997 Kyoto Summit on Global Climate Change). These events have drawn international attention to the need to create environmentally and socially sustainable approaches to development.

I begin this chapter with an examination of the concept of and the controversy over sustainability, and various ways in which sustainable agriculture has been defined. Richard Harwood (1990: 4) comments that “to understand the process by which definitions of sustainable agriculture are translated into substance in any national setting, some sense is needed of public agendas, the translation of some of those agendas into policy and the roles of agendas and policy in development.” In the remainder of this chapter, I examine how different agendas and events have shaped official and alternative discourses on sustainable agriculture. In analyzing the official/dominant discourse on sustainable agriculture, I focus on the role of the state, institutions of agriculture science, and agribusiness in shaping zero tillage as part of the official model for sustainable agriculture. In the investigation of the alternative discourse, I look at the incorporation of organic farming practice in the model promoted by a large part of the sustainable agriculture movement.
3.2 Sustainability: The Concept and the Controversy

In 1987 the United Nations' World Commission on Environment and Development (also known as the Bruntland Commission) published *Our Common Future*, which drew international attention to the degradation of natural resources due to contemporary approaches to development. This report declared it was urgent that a new sustainable approach to development be created which would "meet the needs of the present without compromising the ability of future generations to meet those of the future" (World Commission on Environment and Development 1987: 43). Concerns about the effects of industrial progress on society and the environment were voiced long before the Bruntland report was released,\(^1\) but this UN Commission and other international forums that have taken place since the 1970s have elevated sustainability as a global issue.

Sustainability has become a widely used but highly contested concept. It means different things to different people and is invoked in support of divergent projects and goals. "The problem with the term," says sociologist Michael Redclift (1993:170), "is that it is difficult to formulate a definition that is comprehensive, yet retains analytical precision and clarity. Perhaps the appeal of the term lies in the vagueness." This vagueness has led to conceptual controversy as to what exactly is to be sustained. Is it the resource base, economic growth, or human needs for food and fiber? Do we want sustainable production or sustainable consumption? Do the same goals and objectives apply to the South as well as the North? "What is certain," Redclift concludes, "is that human beings are self-conscious actors in the development process"(1993: 171). Redclift argues that there is a need, therefore, to examine the ideologies and social and political relationships that influence the actions of various actors.

Redclift (1987, 1993) and others (e.g. Beus 1995, Beus and Dunlap 1991, Pirages and Ehrlich 1974, Milbrath 1984) contend that although there is a range of definitions and objectives of sustainability, there are two distinctive and opposing ideologies or paradigms.\(^2\) Advocates of the dominant/hegemonic

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\(^1\) e.g., the Luddites, textile workers in England opposed to mechanization, who rioted and organized machine-breaking between 1811 and 1816; the Prairie Agrarian Movement in the early 1900s that organized resistance to the economic and political exploitation of farmers by industrial capitalism and the State; Rachel Carson’s *Silent Spring* (1962) which drew attention to the detrimental effects of industrial agriculture, particularly the increasing use of agrochemicals.

\(^2\) Social paradigm: “a prominent worldview, model or frame of reference through which individuals or collectives in a society interpret the meaning of the external world” (Pirages and Ehrlich 1974: 43).
paradigm support the fundamental principles and goals of the current approach to development and believe that environmental, economic and social problems can be resolved through adjustments (scientific, technological, economic) to the standard development model. This paradigm is based on a belief in economic growth (through a laissez-faire global economy) and the view that nature (natural capital) and human resources (labour, knowledge) are to be managed and utilized for the continued and increasing accumulation of capital. The other side of the debate on sustainability emerges from an alternative/subordinate paradigm that challenges the hegemony of conventional socio-economic and scientific reasoning, and calls for a reform of social values and goals and a reconstruction of community and institutions based on principles of ecology and social justice.

Economic analysis is a common point of departure for these two opposing paradigms. Neoclassical economic theory and practice is the centerpiece of the dominant paradigm. Proponents of the alternative paradigm, such as economist Herman Daly (Daly 1977, Daly and Cobb 1989), argue that continued economic growth does not necessarily contribute to people’s well-being, economic or otherwise, while it inevitably diminishes the earth’s natural capital or ability to provide humans with goods and services. Production and consumption must, therefore, be contained or limited by the physical limits of the natural world. Daly contends that neo-classical economic theory is based on a false picture of what humans are and how they act, an abstraction that relies too heavily on market transactions and incomes as measures of well-being and denies the primary importance of social relationships in human welfare.

The existence of these two competing social paradigms creates distinct divisions among and within social constituencies with respect to the theory and practice of sustainability (Redclift 1993). Powerful alliances have formed between capitalist enterprises and the state to promote the sustainability of a modified conventional approach to development. Support for the alternative paradigm, and for new approaches to sustainability, stems predominantly from a collection of individuals and grassroots organizations coalescing as new social movements (e.g., the environmental, peace, animal rights, anti-nuclear, feminist, and sustainable agriculture movements). The globalization of these new social
movements, along with the globalization of corporations and markets, has produced powerful social forces that are shaping the discourse on sustainability.³

In agriculture, the concept of sustainability has been embraced by virtually every related constituency, including farmers, consumers, environmentalists, researchers, policymakers, rural communities, and farm input manufacturers and distributors. As an abstract symbol, it appears to be "the central goal and rallying cry in agriculture" (Parr et al. 1990: 50). Although the term is often used as if a consensus exists concerning its meaning and desirability, Buttel contends that it is in fact an "ideological fulcrum" in agriculture (Buttel 1993a: 24). Beus (1995) adds that advocates and critics of the dominant model of agricultural development take such divergent positions that they find it difficult to communicate let alone reach any consensus.

Like the concept of sustainable development, sustainable agriculture has been defined by many people in numerous ways. Most take a broad and general approach, using the term to invoke the development of socially, environmentally and economically viable agricultural systems. How these "generic definitions" (Harwood 1990: 4) are translated into substance varies considerably. For some, sustainable agriculture is primarily about field-level cropping practices and the viability of individual farming operations; for others it is an ideology that extends from the personal to the global, relating to such issues as health, food security, social equity, resource management and the environment. Table 3.1 lists some of the definitions of sustainable agriculture that have been developed.

Barry Smit and John Smithers (1993) suggest that differences in the way sustainable agriculture is conceptualized and applied depends largely on what agriculture means to different stakeholders, whose interests tend to focus on particular aspects and at certain levels. Table 3.2, adapted from Smit and Smithers (1993), lists various meanings of sustainable agriculture that are associated with different dimensions in agriculture (natural resource base, production, economic, and social) from the micro-level (field and farm scale), to the regional, to the macro-level (national and global context). For example, at the micro-level (from the field to the farm), the meanings associated with the environment/natural resource base range from soil and water quality, to preservation of native species and wildlife habitat. At

³. In this usage, globalization refers to widespread, global networking and activity.
the macro-level (national to global), the environment is thought of more in terms of ecozone productivity, global climate, continental waters, and biodiversity.

**Table 3.1 Definitions of Sustainable Agriculture**

- **Sustainable agriculture systems are those that are economically viable, and meet society's need for safe and nutritious food, while conserving or enhancing Canada's natural resources and the quality of the environment for future generations. It is an integrating concept that brings together not only resource and environmental quality concerns, but also food safety, pesticide regulation, safety nets and related economic and other social concerns.**
  

- **An agriculture that works with nature to maintain essential ecological processes, guards the wholesomeness and security of the food supply, and maintains economically and socially viable farms and farm communities.**
  

- **An agriculture that can evolve indefinitely toward greater human utility, greater efficiency of resource use, and a balance with the environment that is favorable to both humans and most other species.**
  
  Richard Harwood 1990.

- **A loosely defined term for a range of strategies to cope with several agriculturally related problems causing increasing concern around the world.**
  

- **A philosophy based on human goals and knowledge of impacts, which leads to integration, resource conserving and equitable farming systems which reduce environmental degradation, maintain agricultural productivity, promote economic viability in both short and long term, and maintain stable rural communities and quality of life.**
  
  Francis and Youngberg 1990.

- **Sustainable agriculture is a philosophy and system of farming. It has its roots in a set of values that reflect a state of empowerment, of awareness of ecological and social realities, and of one’s ability to take effective action. It involves design and management procedures that work with natural processes to conserve all resources, promote agroecosystem resilience and self-regulation, and minimize waste and environmental impact, while maintaining or improving farm profitability.**
  
  MacRae *et al.* 1990.
### Table 3.2 Meanings of Sustainable Agriculture by Dimension and Scale

<table>
<thead>
<tr>
<th>Environment/ Natural Resource Base</th>
<th>Micro-Level (Field-Farm)</th>
<th>Regional</th>
<th>Macro-Level (National-Global)</th>
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<tr>
<td>- soil quality</td>
<td>- regional land capability</td>
<td>- ecozone productivity</td>
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<tr>
<td>- water quality</td>
<td>- nature preserves</td>
<td>- global climate</td>
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<td>- preserving native species</td>
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<td>- continental waters</td>
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<td>- preserving wildlife habitat</td>
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</tr>
<tr>
<td>Production</td>
<td>- yields</td>
<td>- land use patterns</td>
<td></td>
</tr>
<tr>
<td>- efficiency-labour and inputs</td>
<td>- regional productivity</td>
<td>- national/global food supplies</td>
<td></td>
</tr>
<tr>
<td>- nutrient/energy recycling</td>
<td>- health and safety</td>
<td>- health and safety</td>
<td></td>
</tr>
<tr>
<td>- management/stewardship</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- specialized</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- integrated diversity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- health and safety</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic</td>
<td>- farm viability</td>
<td>- community viability</td>
<td></td>
</tr>
<tr>
<td>- production costs and profitability</td>
<td>- diversification</td>
<td>- government policy</td>
<td></td>
</tr>
<tr>
<td>- marketing</td>
<td></td>
<td>- global markets</td>
<td></td>
</tr>
<tr>
<td>- environmental costs of production</td>
<td></td>
<td>- international trade agreements</td>
<td></td>
</tr>
<tr>
<td>- on-farm diversification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>- maintaining a 'way of life'</td>
<td>- health/viability of rural communities</td>
<td></td>
</tr>
<tr>
<td>- equity issues: e.g., age, gender</td>
<td>- equity issues: e.g., age, gender, race, ethnicity, spiritual, philosophical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- health and safety</td>
<td>- equity issues: age, gender, race, ethnicity, spiritual, philosophical</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- North versus South</td>
<td></td>
</tr>
</tbody>
</table>

Source: adapted from Smit and Smithers 1993.

From an agricultural science perspective, agriculture is essentially defined and analyzed with focus on the biophysical aspects of production and the effects of various management practices and technologies on the productive capability of the land (predominantly within a local context, but also at regional and macro-levels). Ecologists and environmentalists, on the other hand, are more concerned about the effects of agricultural practices and products on the biodiversity and integrity of ecosystems, from the local to the global. For economists, agriculture at the micro-level is analyzed in terms of
profitability (costs and returns) and as contributing to the overall economic viability of the region/province or the nation.

Agricultural production is generally viewed by all constituencies as an essential means of meeting human needs for food and fiber. For some, concern focuses on the need to increase global productivity to meet the demands of a rapidly growing world population (e.g., Avery 1997, Lal et al., 1990). Others argue that productivity is not the major issue, rather that the social and political dimensions of food production and distribution need to be addressed including equitable access to food and land, health and food safety, and the viability of farming and rural communities as a distinct ‘way of life’ (e.g. Allen 1993; Kirchenmann 1997, Redclift 1993). Those emphasizing this socio-political perspective link the concept of sustainable agriculture to human rights. They maintain that without guaranteeing the rights of the individuals involved to participate in decisions that affect their lives and the environment in which they live, sustainable agriculture cannot be achieved (Redclift 1993).

Dunlap and Beus (1991) contend that the fundamental differences between perceptions about sustainable agriculture can be attributed to adherence to competing dominant and alternative social paradigms. Advocates of the dominant paradigm support the current scientific and industrial approach to agricultural development, set within the context of a competitive global system. Those supporting the alternative paradigm believe sustainability can only be achieved through a decentralized and ecological approach to agriculture. Table 3.3 lists the key elements of these competing agricultural paradigms, as identified by Beus (1995). Beus points out that the beliefs and values of all, or even most, individuals or constituencies are not represented by or fit neatly into one or the other paradigm. Nevertheless, he argues that this paradigmatic analysis is useful in “facilitating comparisons and sharpening the focus of the debate” (Beus 1995: 25). The characterization of the paradigms presented by Beus is based on reviews of the writings of prominent American proponents of conventional and alternative agriculture. In the following sections of this chapter, I examine in greater detail some of differences in ideologies, epistemologies and practices associated with each of these paradigmatic positions in the Canadian context.
<table>
<thead>
<tr>
<th>Dominant/Conventional Agricultural Paradigm</th>
<th>Alternative Agricultural Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Centralization</strong></td>
<td><strong>Decentralization</strong></td>
</tr>
<tr>
<td>- centralized control over production, processing and marketing</td>
<td>- more local/regional production, processing and marketing</td>
</tr>
<tr>
<td>- concentrated production, fewer and larger farms, therefore fewer farmers and rural communities</td>
<td>- dispersed production (more farms and farmers), control of land, resources and capital</td>
</tr>
<tr>
<td><strong>Dependence</strong></td>
<td><strong>Independence</strong></td>
</tr>
<tr>
<td>- scientific and technological approach to production, dependence on experts</td>
<td>- smaller, lower input production units, less reliance on external sources of knowledge, energy and credit</td>
</tr>
<tr>
<td>- reliance on external sources of energy, inputs, and credit</td>
<td>- more personal and community self-sufficiency</td>
</tr>
<tr>
<td>- predominant reliance on long-distance markets</td>
<td>- primary emphasis on personal values, knowledge, skills</td>
</tr>
<tr>
<td><strong>Competitive</strong></td>
<td><strong>Community</strong></td>
</tr>
<tr>
<td>- competitive self-interest</td>
<td>- increased cooperation</td>
</tr>
<tr>
<td>- farming is a business</td>
<td>- farming is a way of life and a business</td>
</tr>
<tr>
<td>- emphasis on efficiency, flexibility, quantity and increasing profit margins</td>
<td>- emphasis on a holistic approach to production-optimizing all parts of the agroecosystem</td>
</tr>
<tr>
<td>- emphasis on keeping up with latest technologies, and increasing size of operation</td>
<td>- emphasis on appropriate technology and scale of production</td>
</tr>
<tr>
<td>- no commitment to the traditional family farm and rural communities as an important ‘way of life’</td>
<td>- commitment to traditional family farm and rural communities as an important ‘way of life’</td>
</tr>
<tr>
<td><strong>Domination of Nature</strong></td>
<td><strong>Harmony with Nature</strong></td>
</tr>
<tr>
<td>- humans are separate from and superior to nature</td>
<td>- humans are part of and dependent on nature</td>
</tr>
<tr>
<td>- nature consists mainly of resources to be used for economic growth</td>
<td>- nature provides resources but is also valued for its own sake</td>
</tr>
<tr>
<td>- imposition of human time frames and systems on natural cycles</td>
<td>- working with natural nutrient and energy cycles</td>
</tr>
<tr>
<td>- productivity maximized through industrial inputs and scientific modifications</td>
<td>- working with an ecological/closed system approach-developing a diversified and balanced system</td>
</tr>
<tr>
<td>- appropriation and substitution of natural processes and products with scientific and industrial processes and products</td>
<td>- incorporating more natural products and processes</td>
</tr>
<tr>
<td>- using cultural methods to build soil health</td>
<td><strong>Diversity</strong></td>
</tr>
<tr>
<td>- limited genetic base used in production</td>
<td>- broad genetic base</td>
</tr>
<tr>
<td>- most crops grown in monocultures</td>
<td>- incorporation of polycultures, complex rotations</td>
</tr>
<tr>
<td>- separation of crops and livestock production</td>
<td>- integration of crops and livestock</td>
</tr>
<tr>
<td>- standardized production systems</td>
<td>- heterogeneity of farming systems</td>
</tr>
<tr>
<td>- predominance of a specialized, discipline-oriented scientific approach</td>
<td>- interdisciplinarity (natural and social sciences). participatory (inclusion of farmers), systems-oriented</td>
</tr>
<tr>
<td><strong>Specialization</strong></td>
<td><strong>Restraint</strong></td>
</tr>
<tr>
<td>- exploitation:</td>
<td>- full-cost accounting</td>
</tr>
<tr>
<td>- external costs (environmental, social) often ignored as short-term benefits outweigh long-term consequences</td>
<td>- short- and long-term outcomes equally important</td>
</tr>
<tr>
<td>- reliance on non-renewable resources</td>
<td>- greater use of renewable resources, conservation of non-renewable resources</td>
</tr>
<tr>
<td>- high consumption/materialism propels economic growth</td>
<td>- sustainable consumption, simpler lifestyles</td>
</tr>
<tr>
<td>- hegemony of scientific knowledge and industrial approach, results in loss of indigenous/local knowledge and cultures</td>
<td>- equitable access to basic needs</td>
</tr>
<tr>
<td></td>
<td>- recognition and incorporation of other knowledge and ways of doing, allowing for a more heterogeneous knowledge base</td>
</tr>
</tbody>
</table>

Source: adapted from Beus 1995
3.3 The Official Discourse: Government Policy, Agriculture Science, Agribusiness and Zero Tillage

Buttel (1995) contends that the major factor creating widespread support for the concept of sustainable agriculture has been the recognition of environmental degradation, which began to coalesce during the 1960s and 1970s. The development of a global environmental consciousness in the later part of this century is, according to McCormick, "part of a cumulative, broad-ranging, long-term change in human attitudes arising out of a series of independent... and local responses to changes brought about by industrialism" (McCormick 1995: 1). McCormick refers to Henry David Thoreau, George Marsh and John Muir as key figures in raising awareness of environmental issues in America during the late 1800s. But it was not until nearly a century later that a global environmental movement emerged and attention was drawn to the environmental impacts of an industrial approach to agriculture. The publication of Rachel Carson's *Silent Spring* (1962) is often identified as a significant turning point in awareness about the links between a high-input, industrial approach to agriculture, and environmental degradation and consequent effects on the health of human and animal populations.

In Canada, from the 1960s to the 1980s, there were numerous reports by farmers and scientists that significant soil degradation (loss of topsoil and soil fertility, increasing compaction and salinity) was occurring. One concomitant result was an increased use of synthetic fertilizers to sustain high yields (e.g., The Prairie Farm Rehabilitation Administration 1983, Rennie 1986). Other environmental issues in agriculture were also being identified and examined during this time, including loss of wildlife habitat and biodiversity, and the effects of agrochemical use on soil and water quality and human health. The issue of greatest concern to agricultural scientists and economists was declining soil quality and the impact on productivity (e.g., Agriculture Canada 1985; Anderson and Knapik 1984; Rennie 1986; Science Council of Canada 1986; Standing Committee on Agriculture, Fisheries and Forestry 1984). Different hypotheses were developed to explain the causes of deteriorating soil quality and how to address the problem (Hall 1998). Some pointed to the emphasis on maximizing production of a limited number of crops as the major problems (PFRA 1983, Science Council of Canada 1986, Sparrow 1984). One proposed solution was to increase the diversity of crop rotations, while limiting summerfallowing, in order to reduce the need for inputs. Another solution was to retire marginal land from production. There were also some farmers and
scientists making the case for a more radical change in farming practices (and throughout the agriculture system) to an organic approach, in which diversified crop rotations and other related cultural methods replaced the use of agrochemicals (Beveridge 1979; Cullimore 1979; Grussendorf 1968; Hanley and Morrison 1980, Hill 1977). Others identified intensive tillage and summerfallowing as the main cause of soil erosion and fertility problems, and recommended increased use of soil conservation tillage practices designed to reduce soil erodibility and retain soil moisture and surface residues (Rennie 1986).

The severe and prolonged drought in the Prairies during the 1980s underlined the environmental and socio-economic impacts of soil degradation. The Science Council of Canada (1986) estimated that on-farm costs of soil degradation amounted to $1.3 billion per year in lost productivity. In 1984, the Standing Senate Committee on Agriculture, Fisheries, and Forestry, chaired by H.O. Sparrow, released the report *Soil at Risk: Canada’s Eroding Future*, which identified the major degradation processes affecting soils in every region of Canada. In addition to drawing attention to the magnitude and pervasiveness of the problem, the report also identified certain federal and provincial policies (e.g., Crop Insurance, Western Grain Stabilization, and the Western Grain Transportation Act) as undermining soil conservation by encouraging such practices as the cultivation and cropping of marginal lands, specialized grain production, and the use of summerfallowing. The report recommended policy and program reform in support of environmental sustainability. The 1986 National Agriculture Strategy stated that “overcoming soil deterioration is one of the greatest challenges that must be met if the future of the Canadian agriculture and food sector is to be assured.” (Federal-Provincial Agriculture Committee on Environmental Sustainability. *Growing Together: A Report to the Ministers of Agriculture*, 1990: 9).

In 1989, the federal government responded to these concerns by developing a National Soil Conservation Program (NSCP). This three-year program delivered provincially through local organizations to ensure farmer participation, took a broad-based approach to dealing with the problem. It included the establishment of the Permanent Cover Program (to take marginal land out of crop production), as well as the promotion of soil conservation methods. Of these various conservation practices, methods that reduced summerfallowing and tillage operations were increasingly being promoted by agricultural scientists as expedient and effective ways to deal with soil erosion.
During the 1980s and early 1990s, a number of other national and international factors influenced further changes in federal agricultural policies and programs. In addition to the environmental crisis in Prairie agriculture, there was also an economic crisis, as farmers faced the collapse of world grain markets, high debt loads, and falling land prices (e.g., Fulton et al. 1989; Science Council of Canada 1992). The economic crisis extended beyond the farm. Federal and provincial governments had accumulated large deficits. A combination of the national debt, Canada's involvement in free trade agreements (NAFTA and GATT), and criticism that certain policies and programs were undermining conservation efforts, influenced the government's decision to withdraw many subsidies and support programs for Prairie agriculture. The National Farmers Union, Canadian farmers' critical voice and political advocacy group, lobbied the government to retain support programs for Prairie farmers. The political power of this organization was declining, however, as farmers became a smaller and divided constituency (Stirling and Conway 1988). There was other international pressure, stemming from the Bruntland Commission as well as from strengthening environmental and sustainable agriculture movements, for nation-states to develop more environmentally and socially sustainable approaches to agriculture.

In 1989, in response to the wide range of concerns about agriculture and the environment, the Federal government carried out "the most comprehensive review of agriculture ever undertaken in Canada" (Federal-Provincial Agriculture Committee on Environmental Sustainability 1990: 1). Following this review, in 1990 the government produced two important documents, Growing Together, which addressed specific agricultural issues, and Canada's Green Plan which was a response to the broader range of environmental issues in Canada. Both of these documents reflect the transformation of the government's position on agriculture and the environment that had been taking place during 1980s.

In Growing Together four goals are identified as critical to the future of the agri-food industry: (1) more market responsiveness, (2) greater self-reliance, (3) recognition of regional diversity, and (4) increased environmental sustainability. The emphasis is on the adaptation and restructuring of agricultural sectors within the context of free trade agreements and changing global markets. Specific environmental objectives are to be met, primarily to ensure "the long-term productivity and
competitiveness of the agri-food industry" (Federal-Provincial Committee on Environmental Sustainability 1990: 2). Within this context, self-reliance in the agricultural system does not refer to a policy of self-sufficiency in food production, but rather that agricultural producers will have to trade in more liberalized markets with less government protection. Although there is reference in the Foreword of the document to integrating social, environmental and economic dimensions, throughout the remainder of the report there is no mention or discussion of social issues.

Following the release of Growing Together and Canada’s Green Plan, opportunities were created for public and internal review of the definition and objectives for sustainability outlined in these documents. A number of reports were solicited and submitted to the government by various organizations and agencies, in which definitions of, and objectives for, sustainable agriculture were presented (Anderson et al. 1990; Faculty of Agriculture and Food Sciences, University of Manitoba 1992; National Farmers Union 1990; Science Council of Canada 1992; Standing Committee on Agriculture 1992). As indicated by the following quotations, these reports are critical of conventional goals and approaches to agricultural development, and call for “a recasting of government policy and agriculture institutions” (Science Council of Canada 1992), in order for these institutions to accomplish the broad range of social and economic objectives identified for sustainable agriculture:

Agriculture is at the crossroads, where the old philosophy of grow, grow, grow is outmoded, but the debate on its replacement has just begun (Standing Committee on Agriculture 1992. The Path to Sustainable Agriculture. 1992:2).

The concept of sustainable agriculture embraces a broad range of interests and diverse set of goals. Its implementation will require policies that realign the agriculture-food system....and policies for science and technology that address their role in the context of environmental needs and social objectives (Science Council of Canada 1992. Sustainable Agriculture: The Research Challenge 1992: 30-31).

While the scientific gains associated with a strong reductionist approach have been impressive, certain innovations and technologies permitted exploitation of areas inherently unsuited for primary production, and the adoption of practices which clearly are not sustainable..... Much of the current knowledge on the subject (of sustainable agriculture) is in the heads of retiring farmers, experienced in husbandry methods which produced crops, aided fertility of land, controlled pests and sustained farm diversity, all without the use of modern agriculture technology. The unique nature of the land and ecosystem on farms requires that institutional systems bring together farmers, researchers, and ecologists, to work on education, information and adapting strategies for sustainable agroecosystems (Faculty of Agriculture and Food Sciences, University of Manitoba. 1990. Sustainable Agriculture: A Prairie Perspective 1990:182-183).
The government's version of agricultural sustainability, as outlined in a revised edition of Canada's Green Plan (Minister of the Environment 1992) and in subsequent agriculture policy documents (e.g. Agriculture and Agri-Food Canada, National Agriculture Strategy: Future Directions for Canadian Agriculture and Agri-Food 1995; Profile of Production Trends and Environmental Issues 1996) was consistent with the position first outlined in Growing Together. These documents present a clear message that the government is primarily committed to trade liberalization and to maintaining the productivity of the resource base. A distinction is made between socio-economic viability, which is linked to international trade arrangements, and sustainability, which is defined within certain environmental parameters. The links between these two goals is described in the 1995 National Agriculture Strategy:

Over time, trade liberalization is expected to lead to a more market oriented system of production, with fewer incentives for destruction and wasteful overproduction that has negative environmental effects (National Agriculture Strategy 1995: 25).

This government version of sustainable agriculture reflects the continued reliance on a traditional scientific and neo-classical economic framework to examine the issues facing agriculture and to devise a formula for sustainability. This perspective and the focus on economic and technical strategies for sustainability exclude social issues and a broader range of economic and environmental issues from the equation. Even though it is acknowledged that meeting the objectives identified will require structural and operational adjustments in farming systems (in order to become more efficient, flexible, and competitive within less regulated global markets), the socio-economic effects of these adjustments on farmers and farming communities are ignored. Farming continues to be seen as a technical activity, which can be adjusted to meet criteria established by the state, institutions of agricultural science, and dominant economic forces.

It is within the context of a prevailing emphasis on certain economic and environmental objectives, that conservation tillage practices, particularly zero tillage, became identified as the way to meet these objectives and, hence, as the route to farm-level sustainability. The selection of zero tillage as a sustainable practice was backed by numerous scientific and economic studies which showed that by eliminating tillage and summerfallowing, soil and water erosion could be reduced, which would also allow farmers to increase the yearly productive capacity of the land base and maintain high yields.
(Lindwall et al. 1998, Lindwall and Larney 1993, Lal et al., 1990). Although some environmental and economic disadvantages are identified in these and other studies, overall the benefits are said to outweigh the problems.

In a series of papers, Alan Hall (1994, 1997, 1998) critically examines how the development and promotion of zero tillage in Ontario emerged as part of the dominant discourse on sustainable agriculture. Hall argues that the government version of sustainable agriculture has been reconstructed and abbreviated, so as to correspond with restructuring objectives of powerful political and economic forces represented by international trade agreements and transnational agribusiness corporations. Although support for sustainable agriculture is claimed, the emphasis is on adjusting to trade liberalization and global markets, while addressing only certain environmental problems. Hall refers to the making of this version of sustainable agriculture, one that appears to meet public demands for environmental protection while also meeting economic demands of dominant capitalist forces, as what Gramsci (1971) identifies as "reproducing hegemony". The industrial model has been modified and refashioned to make it appear to be sustainable and therefore acceptable. Hall comments that the impression is given that these sustainable solutions "have been achieved without any conflict, through a consensus of meaning and desirability," that "significant changes are taking place in government programs, in the technology, and in farmers' adoption of innovations" (Hall 1998: 224, 225). The following excerpt from the 1995 National Strategy for Agriculture and Agri-Food illustrates this point:

Through a proactive, partnership-based approach involving both the agriculture and agri-food sectors and government, much has been accomplished in dealing with the environmental issues facing the sectors. Producers are developing and enforcing codes of practice designed to reduce the environmental impacts of primary production (Agriculture and Agrifood Canada 1995).

Hall argues that increasing the efficiency, flexibility and productivity of farming through increased dependency on scientific and industrial inputs, while ignoring the impact on family farms and rural communities, is compatible with industrialization, not sustainability.

In Saskatchewan, the path to agricultural sustainability chosen by the government is clearly one of continued industrialization, as is evidenced by the development and promotion of precision farming, biotechnology, large scale livestock operations and zero tillage. All of these solutions are compatible with
a capital intensive, industrial model of agriculture. In the following section I examine the development of zero tillage in Saskatchewan.

3.3.1 Zero Tillage

Zero tillage, also known as no-till or direct seeding, is a system of planting and growing crops in previously untillled soil (Lindwall and Larney 1993). This approach is one of several conservation tillage methods practised in Saskatchewan (e.g., minimum tillage, mulch tillage or stubble-mulching, chemical summerfallow, ridge tillage, strip tillage). Conservation tillage is characterised by its potential to reduce soil erosion and conserve soil moisture relative to conventional tillage systems, and does not necessarily involve less tillage (Carter 1994). A practical field measurement or indicator presently used to gauge conservation tillage is the degree of soil cover (a minimum of 30 percent) provided by the retention of plant residues at the soil surface from the previous crop. Stubble mulching methods, which have been in use since the 1930s, are therefore considered to be conservation tillage practices even though tillage may not be reduced. In chemical summerfallow systems, vegetative growth is controlled by herbicides during the fallow period, but tillage and/or herbicides are used during the cropping season. Tillage is eliminated in a zero tillage system, resulting in increasing dependence on agrochemicals to maintain soil fertility and control diseases and pests.

In recent years, zero tillage has been promoted by agricultural institutions and agribusinesses as the preferred method of soil conservation on the Canadian Prairies for both environmental and economic reasons (e.g., Carter 1994, Lindwall and Larney 1993, Lindwall et al. 1998). Soil quality is improved through the reduction of soil and water erosion, and the retention of soil moisture and soil organic matter. Economic benefits are derived from decreases in fuel use, machinery and equipment inventory, and the potential for increased yields over time. It is also claimed that by eliminating tillage operations, zero tillage reduces labour/time requirements.4

Problems associated with the zero tillage approach have also been identified. An increased dependency on the use of agrochemicals increases the risks to human (McDuffie et al. 1995) and

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4. Labour/time as it is used here, encompasses both human labour and machine time.
environmental health (Pimental et al. 1992), and has been accompanied by increased genetic resistance to pesticides in weed and insect populations (e.g., Morrison and Devine 1993). Zero and minimum tillage systems are most dependent on glyphosate (Roundup), a broad-spectrum herbicide, for weed control. Although scientists originally claimed there was a very low probability of resistance to Roundup, due to the chemical make-up and action of the herbicide, some weeds have begun to develop resistance (Western Producer July 28 1994, pp. 36). Roundup has also been identified as one of the safest pesticides in use, but a recent study has shown a positive correlation between exposure to glyphosate and the incidence of non-Hodgkin's lymphoma (Hardell and Eriksson 1999). Increased use of synthetically manufactured agrochemicals in a zero tillage system also raises concerns about non-renewable energy use and the impact on global climate change (Western Producer March 11, 1999). Carbon dioxide, one of the greenhouse gases contributing to global climate change, is a by-product during the manufacturing of fertilizers and pesticides. Of these manufacturing processes, the production of nitrogen fertilizers results in the highest use of fossil fuels and consequent emission of carbon dioxide. About one kilogram of carbon dioxide is produced by the manufacture of one kilogram of nitrogen fertilizer (Janzen et al. 1998). The production of nitrous oxide, another greenhouse gas, occurs as a result of denitrification in zero tillage systems and is also associated with the use of nitrogen fertilizers. Although nitrous oxide emissions from agricultural sources are low relative to carbon dioxide, nitrous oxide is considered to be a serious problem as one unit is equivalent to 310 carbon dioxide equivalents (Janzen et al. 1998). Zero tillage may also be promoting structural changes in farming operations and in rural communities (Gertler 1999). By making it possible for farmers to farm larger areas in less time, zero tillage facilitates the trend to increasing farm size and decreasing number of farms. The advantages and disadvantages of zero tillage systems are summarized in Table 3.4.
Table 3.4 Advantages and Disadvantages of Zero Tillage

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-increase soil organic matter</td>
<td>-changes in weed populations</td>
</tr>
<tr>
<td></td>
<td>-carbon sequestration</td>
<td>-increased use of herbicides</td>
</tr>
<tr>
<td></td>
<td>-preservation of soil structure</td>
<td>-increased herbicide resistance</td>
</tr>
<tr>
<td></td>
<td>-increase in earthworm pop.</td>
<td>-increases in diseases and pests</td>
</tr>
<tr>
<td></td>
<td>-prevent soil and water erosion</td>
<td>-increased denitrification</td>
</tr>
<tr>
<td></td>
<td>-conservation of soil moisture</td>
<td>-decreased nitrogen availability</td>
</tr>
<tr>
<td></td>
<td>-improved aeration of soil</td>
<td>-restricted distribution of soil phosphorus</td>
</tr>
<tr>
<td></td>
<td>-improved infiltration of soil</td>
<td>-energy intensive</td>
</tr>
<tr>
<td>Economic</td>
<td>-decreased fuel use (20-70 %)</td>
<td>-high cost of large-scale and specialized machinery</td>
</tr>
<tr>
<td></td>
<td>-decreased machine inventory</td>
<td>-increased cost of agrochemicals</td>
</tr>
<tr>
<td></td>
<td>-increased production due to more intensive cropping</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-facilitates increased scale of operation</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>-labour and time efficiency in field operations</td>
<td>-facilitates increased farm size which may impact on community structure</td>
</tr>
<tr>
<td></td>
<td>-greater flexibility in decision making</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-smaller range of skills required</td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from Baker et al. 1996

3.3.1.1 Production Trends

In the present decade, significant increases in the adoption of zero tillage have been reported by farmers in Saskatchewan (Table 3.5). According to the agricultural census data, the transition to zero tillage is higher in Saskatchewan than elsewhere in Canada (Statistics Canada 1997). From 1991 to 1996, the amount of land reported to be under zero tillage management more than doubled from 3.3 million acres to 7.3 million acres, or 22 percent of the total seeded area in the Province (Statistics Canada 1997). The accuracy of the census data is, however, being challenged. Recent results from provincial field studies by the Prairie Farm Rehabilitation Administration (PFRA 1999) indicate that there is significantly less land under zero tillage management in Saskatchewan than was reported in the census of agriculture. There are a few possible explanations as to the origins of this discrepancy. There is general agreement among farmers, researchers and extension agents that the terminology surrounding reduced and zero tillage practices is confusing. Direct or one-pass seeding, which is often equated with zero tillage, can in fact be linked to either a minimum tillage or zero tillage system, depending on the degree of disturbance (low or high) created at the
time of seeding. The census questions add to the confusion by not providing enough detail for farmers to identify whether they are practising low disturbance or high disturbance direct seeding. Another possible explanation is that some farmers are claiming to practise zero tillage, even though they are aware they are not, because zero tillage has been extensively promoted as the best management choice. Whatever the reasons are for the statistical discrepancies, many scientists, extension agents and industry representatives maintain that there is little doubt that Saskatchewan continues to lead in the adoption of zero tillage in Canada and probably throughout North America.

Table 3.5 Changes in Tillage Practices on the Prairies, 1991-1996

<table>
<thead>
<tr>
<th>Region (soil zone)</th>
<th>Province</th>
<th>Cropland (% of total area seeded)</th>
<th>Summerfallow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Conventional tillage</td>
<td>Conservation tillage</td>
</tr>
<tr>
<td>Mixed Grassland (Brown)</td>
<td>Alta</td>
<td>66</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Sask</td>
<td>56</td>
<td>46</td>
</tr>
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Studies of the adoption of conservation tillage have suggested that farmers identify zero tillage as a way to achieve both environmental and economic goals (e.g., Benjaminson et al. 1994, Buttel et al.

5. Direct seeding occurs when the crop is seeded (and simultaneously fertilized) into standing stubble from
Gray et al. (1996) agree that economic feasibility is of primary importance to farmers’ adoption of zero tillage and contend that the single biggest economic factor influencing increased adoption was the dramatic reduction in the price of Roundup (Glyphosate), the broad-spectrum herbicide that minimum and reduced tillage systems are most dependent on. In the early 1990s, Monsanto dropped the price of Roundup on the Canadian Prairies from 30 dollars a litre (in the mid 1980s) to 9 dollars a litre. According to Gray et al., this significant change in price made zero tillage more economically competitive with the cost of a conventional tillage system. Others suggest that increases in labour efficiency and cropping flexibility associated with zero tillage are also important reasons convincing farmers to make the transition (Hall 1994) (personal communications in 1995 with an extension agrologist and a soil scientist). Many farmers see zero tillage as a way to farm the land in less time, in order to free up time for off-farm employment and/or enable them to expand or diversify their operation. Farm size and income have been identified as factors having a positive correlation with the adoption of minimum and zero tillage (Benjaminson et al. 1994, Buttel et al. 1990, Heffernan and Green 1986, Pampel and van Es 1977). These studies suggest that due to the high input costs (specialized equipment and agrochemicals) associated with a direct seeding/reduced tillage system, farmers with larger operations and higher incomes are more likely to adopt this approach as they have the necessary capital resources. It has also been suggested that time and labour savings that occur from direct seeding may allow a farmer to reinvest this time and labour into increased farm size (Blair McClinton, personal communication 1999).

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6. The price of Roundup has remained comparatively high in eastern Canada and throughout the United States, where more intensive production systems with higher yielding and higher priced crops (e.g., corn, soybean, tobacco) are prevalent. As a result of the significant price differential in the cost of Roundup between these regions and the Canadian Prairies, there have been incidents of herbicide smuggling across
The development and adoption of zero and minimum tillage in Saskatchewan and throughout the Canadian Prairie region has been characterized as being more than a trend in agricultural production; it has been described as a movement and a revolution.

It’s probably the biggest revolution in farming since 2,4-D and maybe since mechanization. It is a profound change when you think that the history of agriculture is tillage, and in ten years we’ve seen it change into minimum and no-tillage (John Bennet as quoted in Western Producer May 29, 1997 pp. 60).

The conservation tillage movement has forced us to be much more aware of what is happening on the land and broadened our perspective on agriculture’s impact on the environment (Lindwall et al. 1998).

Monsanto refers to zero tillage as “the environmental and economic promise” (Hebblethwaite 1995). An Agriculture Canada scientist commented in 1995:

Zero tillage is giving people new hope. It gives them tools to make changes and to take back control. It gives them ownership.”

Many of those involved in the development of zero tillage— including farmers, researchers and extension agents – express a feeling of excitement of being part of the cutting edge of the new knowledge-based developments in agriculture. Lindwall et al. (1998) describe the links between zero tillage and other “revolutionary” technologies in agriculture – biotechnology and precision farming.

Biotechnology offers considerable potential to reduce our dependence on traditional chemical control of pests and alternatives to inorganic fertilizers. Precision farming will allow us to optimize our inputs and make conservation tillage systems more feasible in the future for many farmers (Lindwall et al. 1998).

The adoption of direct seeding and zero tillage in Saskatchewan according to soil zones was discussed briefly in Section 1.6.3. Since the early 1990s, the highest rates of adoption of these soil conservation methods have been occurring in the drier Brown soil climatic zones. In previous years, the adoption of conservation tillage practices in these zones lagged behind the adoption rate in the Black and Grey zones. Wall et al. (1998) provide their explanation for this early trend.

The main reasons for this were the lack of significant and consistent yield advantages with conservation tillage in monoculture wheat rotations (predominant in the drier soil climatic zones) and the higher costs for weed control on summerfallow areas when using herbicides versus mechanical tillage. In contrast, in the more moist Black soil zone, where tillage was traditionally used much more intensively and extended and diversified cropping were already commonplace, conservation tillage was rapidly adopted. Producers were quick to take advantage of the higher provincial and international borders (confidential communication).
grain yields, particularly for oilseed and pulse crops, and of the savings in labour and machine related costs that this technology offered.

The rapid growth in zero tillage management in the drier regions of Saskatchewan since the early 1990s has been influenced by a number of factors. Reduction in the cost of Roundup made zero and minimum tillage systems more competitive with the conventional tillage/fallow system. With continued low prices for wheat, farmers in this traditional wheat/fallow area began to see zero tillage as a way to make the transition to a more diversified, continuous cropping systems. Farmers in these areas also recognized that drier growing conditions lessened the potential for weed and disease problems in a zero tillage system. Finally, zero tillage seeding and spraying equipment, and other new advances in farm machinery, are ideally suited to the relatively flat and open fields of the large-scale cropping operations common in the drier regions of the Province.

Zero tillage is not well suited to heavy clay soils and poorly drained soils due to increased moisture retention and cooler soil temperatures (Lindwall et al. 1998). Zero tillage in these types of soil results in poor germination and slows organic matter decomposition.

3.3.1.2. Marketing Trends

Agribusinesses involved in the development, manufacturing and sale of agricultural inputs have prospered as a result of the popularity of minimum and zero tillage in Saskatchewan and elsewhere. There has been a revolution in the designs of and demand for large-scale direct seeding equipment, high clearance sprayers and other related farm machinery over the last ten years. Many Saskatchewan-based equipment and machinery manufacturers, such as Flexicoil, Bourgault, Conserva Pak, and Concord, have become world leaders in the development of designs which allow side-placement of fertilizers at the time of direct seeding (Lindwall et al. 1998). With the general trend of increased use of herbicides, insecticides and fertilizers in minimum and zero tillage systems, companies involved in the development, manufacturing and distribution of agrochemicals have also gained considerable profits.
3.3.1.3 History

The planting of seeds in untilled soil was a common practice in early agricultural systems in both the Old and New Worlds (Carter 1994). The modern concept of reduced tillage was first developed in England and the corn-belt of the United States in the 1960s, when the wide-spectrum herbicides paraquat and diquat were released by the Imperial Chemical Industry in England. It was not long after that some Canadian Prairie farmers and researchers, concerned about the effects of conventional tillage and summerfallowing on soil quality, began experimenting with chemical summerfallowing. The expense of repeated chemical treatments and the risk associated with residual-type herbicides limited adoption of this approach, even though research showed that weed control and yields could be maintained with a herbicide-dependent reduced tillage approach (Anderson 1971, Molberg and Hay 1968). Some farmers tried to offset the increased costs of herbicides used in a reduced tillage system by increasing the productive capacity of their fields through the elimination of summerfallow. In addition to further increasing the need for fertilizers and pesticides, this continuous cropping/reduced tillage approach also required seeding equipment that could place seed into moist soil with reduced or no seedbed preparation, while also avoiding mechanical blockage due to high residue left on the soil surface (Larney and Lindwall 1993). As there was no equipment available that could meet these criteria for prairie conditions, farmers began designing and modifying equipment to suit their needs. The first air seeder used on the prairies was developed in the 1960s by Jerome Bechard, a Saskatchewan farmer (Faller 1998). Made of tanks with a fan that pneumatically delivered the seed and fertilizer to furrows created by standard cultivators, this design made it possible to combine tillage and seeding in one operation. Bechard’s innovation became the industry standard for air seeders.

By the late 1970s farm equipment manufacturers began to respond to farmers’ demands for new seeding technology by making further developments in air-seeders and drills suited to prairie conditions. Agrochemical companies were also developing more broad-spectrum non-residual herbicides (e.g., glyphosate (Round-up), glyphosate-trimesium (Touchdown) and glyfosinate-ammonium (Buster),

7. According to Lindwall et al. (1998), much of the interest in continuous cropping and zero tillage in Saskatchewan was a consequence of a renewed interest in winter wheat production between 1977 and 1984, and the importance of a zero tillage system for winter survival of the crop (Fowler et al. 1976).
imidazolinones and sulphonylureas) (Carter 1994). But these herbicides were costly and the use of them in reduced tillage systems could as much as double the cost of production relative to a conventional tillage system. In addition to the economic hurdles, some agricultural scientists also expressed concern about potential problems in soil fertility with a zero tillage system, due to decreased mineralization and immobilization of soil nitrogen, and denitrification caused by lower soil temperatures and increased moisture (Lindwall et al. 1998).

Beginning in the mid 1980s, certain events occurred that greatly improved the acceptance of zero tillage in the Prairie Provinces. The drought of the 1980s drew public and political attention to the effects of conventional cropping practices on soil quality and to the need for improved farming methods. Partnerships were formed among agribusiness corporations, agricultural scientists and farmers interested in developing and promoting reduced tillage methods as solutions to soil degradation. As a result of these partnerships, some significant advances were made in improving these practices for the prairies and in gathering scientific evidence that these were viable solutions to soil conservation problems. Industrial innovations, initially in agrochemicals and later in equipment and machinery, have been critical to the development of zero tillage. Agricultural scientists and extension agents have been instrumental in the identification, quantification and promotion of the potential contribution of zero tillage to the environmental and economic sustainability of agriculture.8 Another factor in the success of zero tillage in Saskatchewan can be attributed to the role of the Saskatchewan Soil Conservation Association (SSCA).

The SSCA is a non-profit organization that was established in 1987 by farmers and researchers promoting soil conservation in Saskatchewan. Similar organizations, the Manitoba-North Dakota Zero Tillage Farmers Association (MANDAK) and the Alberta Conservation Tillage Association (ACTS), were established during the 1970s and played an important role in providing support and disseminating scientific and practical information to farmers throughout the Prairies. In 1989, the SSCA was selected as the key organization responsible for carrying out extension work in Saskatchewan for the National Soil Conservation Program (NSCP). This raised the profile of the organization throughout the Province and

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8. The Agriculture Canada research station at Indian Head, Saskatchewan is identified as the having been the first center for zero tillage research and extension in the Province. Dr. Guy Lafond and Dr. Doug Dirksen, in particular, are credited as having taken a lead role in zero tillage research in Saskatchewan.
also provided funding for ten professional agrologists to administer and extend the program. In addition to the government funding for SSCA, there was also money coming from memberships and a relatively minor corporate contribution.

As the provincial organization delivering the NSCP program, the SSCA’s mandate was to promote a variety of approaches facilitating soil conservation, such as contour cultivation, shelterbelts, grassed waterways, crop rotations, reduced summerfallowing, and the range of conservation tillage practices. In 1994 a shift occurred in the financial structure of the organization which resulted in a narrowing of the SSCA mandate to the promotion of zero tillage. With the end of the NSCP, federal and provincial governments had decided to terminate core funding for the SSCA. After some negotiation, the organization was able to convince government to continue to provide funding (through the National-Provincial Greenplan) by matching the funding guaranteed by two corporate sponsors, Monsanto and Transalta Utilities. Monsanto, as the transnational agribusiness corporation producing Roundup and other agricultural inputs, had an obvious economic interest in the promotion of zero tillage as the solution to environmental sustainability. The links between sustainable development, zero tillage and Monsanto (Roundup) are described in the Monsanto advertisement shown in Figure 3.2. Transalta, a transnational utilities corporation based in Alberta, became interested in supporting zero tillage for its potential to sequester carbon in the soil. Recognizing the likelihood of international regulation of the production of greenhouse gases, and being a major contributor to carbon dioxide emissions, Transalta was looking for ways to support activities that could capture or sequester carbon. Research was indicating that reduced tillage systems, particularly zero tillage, had increased levels of soil organic matter, containing carbon compounds (Transalta representative, personal communication 1995). Also by eliminating tillage, the use of fuel decreased in zero tillage systems and therefore less carbon dioxide was released into the atmosphere. By funding the SSCA to promote zero tillage, Transalta claimed that it was investing in the carbon sequestration potential of zero tillage and hence was indirectly lowering the corporation’s carbon emission score.
Consider: 25 billion tons of topsoil lost each year. Can it be stopped? Monsanto Company is working with others to try. It's part of how we're piecing together efforts on sustainable development.

Sustainable development means meeting the demands of people today while preserving the capacity of the environment to provide for the future generations. Achieving sustainability means creating economic growth and improving the quality of life while conserving environmental resources.

For further information, visit our website at www.monsanto.com

Figure 3.1 Zero Tillage • Sustainable Development • Monsanto

With government funding, corporate sponsorship and membership fees, the SSCA now has a yearly operating budget of $600,000. In addition to the administrative staff, six regional agrologists are hired to provide information and extension services to farmers. Many of the SSCA staff have agricultural degrees and some have previous experience working in the agrochemical or machinery industries. The SSCA organizes an annual zero tillage/direct seeding conference and trade show that generally attracts close to a thousand participants from across the Northern Great Plains. There are also regional meetings, field demonstrations and training sessions on zero tillage hosted by the SSCA throughout rural Saskatchewan. In all of these events, corporate involvement and sponsorship is clearly acknowledged.
The SSCA also pays tribute to the important role of farmers and local farm organizations in the development of conservation tillage. SSCA conferences include farmers’ presentations of their experiences with zero tillage farming systems along with more technical presentations by scientists and industry representatives. Awards are given at each annual meeting to farmers and local soil conservation clubs for outstanding achievements in innovation and leadership.

3.4 The Alternative Discourse: The Sustainable Agriculture Movement and Organic Farming

The emergence of the sustainable agriculture movement is traced by some to the late 1970s (Allen 1993, Sachs 1992) or early 1980s (Buttel 1993a). Lockeretz (1986) contends that the ideology of the movement evolved over a long period of time, as a synthesis of ideas, originating from a variety of sources, out of various motivations. Concerns about the environmental and health issues associated with modern agricultural production, particularly resource depletion and pesticide contamination, have played a central role in shaping the sustainable agriculture movement (Anderson 1995, Buttel 1993a). There has also always been a social justice component to the movement, which links sustainable agriculture to the maintenance of the traditional family farm, rural communities, and equitable distribution of nutritious food. Sustainability is, therefore, cast as a challenge to the industrialization and globalization of agriculture (e.g., Berry 1977). A variety of philosophical, ideological and theoretical influences have been identified, such as the environmental movement (Beus 1995; Buttel 1992, 1995), agrarianism (Buttel 1993a, Pfeffer 1992), feminism (Allen and Sachs 1991), the sociology of agriculture (Buttel 1993a), the sociology of science and technology (Busch 1984; Buttel 1993b), and post modern social theory (Scoones and Thompson 1994).

The practice of sustainable agriculture, as advocated by the movement, is based on a model of ecological and economic self-sufficiency of local agroecosystems (e.g., Hanley and Morrison 1980, MacRae et al. 1989, Lockeretz 1986). This is accomplished by substituting dependency on external inputs and distant markets with on-farm resources and the development of local and regional markets. The movement maintains that due to the inherent and important ecological and social diversity of agroecosystems, there is no universal methodological or technological fix for sustainability. Rather, each
farmer must choose appropriately from a variety of approaches and strategies in order to work with and enhance on-farm resources, both biophysical (e.g., nutrient and water cycles, soil quality, soil microfauna, and energy flows) and human (e.g., labour, skills, knowledge, culture). A number of different terms and approaches have been included to describe and identify sustainable farming methods, including low-input, regenerative, biological, ecological, agroecological, permaculture, alternative, organic, biodynamic, and natural. Organic and biodynamic farming have attained a particular prominence within the movement. Advocates and practitioners of these methods have played a central role in the establishment and development of the alternative movement. To proponents of these methods, the avoidance of synthetic agrochemicals and the enhancement of natural and local components are seen as essential to the establishment of safe and healthy food and ecosystems, benefiting both farmers and consumers. This approach is also seen as a form of active resistance to the corporatization and industrialization of agriculture since it reduces dependence on external commercial industrial inputs.

Although farm production is widely recognized as an important component of developing sustainable agriculture, some critics believe it has received too much emphasis at the expense of other important issues such as equitable access to food and farmland, and the sustainability of rural communities (Allen 1993, Anderson 1995, Buttel 1993a). Developing and assessing farming methods for sustainability has attracted the attention of the agriculture establishment, which Buttel contends has led to evaluation and appropriation of certain alternative production practices by science and industry in order to give the impression they have created the solution. Allen adds, "the concept of sustainable agriculture has been tolerated, and aspects of it even embraced by the agriculture establishment, provided it fits or presents limited opposition to the industrial model" (Allen 1993: 13). Anderson and Buttel suggest that it is important for the movement to revisit and work with the broad range of objectives identified for sustainable agriculture, in order to create a socially and environmentally sustainable agri-food system.

The array of environmental, economic and social issues encompassed by the sustainable agriculture movement has elicited interest and participation from a wide range of individuals, including some social and natural scientists from mainstream institutions (Anderson 1995, Buttel 1993a). In surveying the North American literature on sustainable agriculture, it appears that the academic
community in the United States has been more actively involved than the Canadian academic community in the research and debate on sustainable agriculture. This can be largely attributed to differences between the two countries in the availability of public and private funding (personal communications with David Granatstein 1998, Adrian Johnson 1995, Nancy Matheson 1995).

The 1985 United States Farm Bill supported the development of sustainable low-input agriculture research and education. In 1988 the Low-Input Sustainable Agriculture (LISA) program was established to meet these objectives. Now known as the Sustainable Agriculture Research and Education program (SARE), this federal program continues to provide funding for community-based initiatives for sustainable agricultural alternatives. In many cases academics from both the social and natural applied sciences have been recruited to contribute their expertise and participate in SARE projects. These opportunities for contact and exchange between academics, farmers and others involved in grassroots sustainable agriculture organizations have contributed to the intellectual groundwork of the sustainable agriculture movement and created networks and alliances. Another component of SARE, the Professional Development Program, provides grants to train extension agents, Natural Resource Conservation Service employees, agricultural field staff and scientists in the principles and practices of low-input agriculture. Several Land Grant universities now have faculty dedicated in part or whole to the study of low-input systems (Granatstein 1998).

Funding for the LISA and SARE programs has been modest relative to the total expenditure on agriculture research and development. It has, however, provided a core of financial support over the past ten years and an institutional legitimacy that has facilitated access to other public agricultural information and research resources (Granatstein 1998). SARE has also attracted additional funding from private foundations and institutes in the U.S.A., such as the Kellogg Foundation, the Jessie Smith Noyes Foundation, the Center for Rural Affairs, the Rodale Institute, the Micheal Fields Institute (Youngberg et al., 1993). This combination of private and public funding has assisted the development of many sustainable/alternative agricultural organizations and institutes in the U.S., which have had a significant influence on the sustainable agriculture discourse and have presented a strong lobbying force for

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9. A 1998 study revealed that the United States Department of Agriculture spent less than one percent of its
institutional and policy change. The power of these advocacy organizations has also been built on growing public demand for changes in the way food is produced and marketed, and for the development of socially and environmentally sustainable rural communities (Anderson 1995).

The sustainable agriculture movement in Canada has received less institutional and private support than its counterpart in the U.S.A., which has affected its development and influence within mainstream institutions (Hill 1997, MacRae et al. 1990). Private funding like that generated by American foundations and institutes is in short supply in Canada due to the nature of Canadian tax laws. There is also an absence in Canada of long-term public funding for investigation of low-input approaches to production and other social and environmental issues identified by the sustainable agriculture movement. The Canadian federal-provincial Greenplan, which was in existence from 1993 to 1997, did provide funding for projects dealing with environmental aspects of agriculture but little of the money was granted to community-based and low-input or organic agricultural projects. Lack of funding has limited the work being done by grassroots organizations, as well as affected involvement and support by the academic community (Hill 1997). The net result is that there has been limited documentation, research, and critical analysis in the Canadian context. All of this has affected the profile and lobbying power of the sustainable agriculture movement in Canada, and has kept alternative low-input approaches to agriculture low on the institutional agenda.

3.4.1 Organic Farming

Organic farming is defined as “an approach to agriculture where the aim is to create integrated, humane, environmentally and economically sustainable agricultural production systems, which maximize reliance on farm-derived renewable resources and the management of ecological and biological processes and interactions, so as to provide acceptable levels of crop, livestock and human nutrition, protection from pests and diseases and an appropriate return to the human and other resources employed” (Lampkin

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10. A scientist from the Greenplan Review Committee for Farm-Based Proposals (a committee consisting of both farmers and scientists) commented that part of the funding had been reserved for research on low-input approaches. The proposals submitted on organic farming were, however, considered to be “unsound” by the committee and therefore they were not funded.
The term "organic," in this usage, does not refer to the type of inputs used or the avoidance of certain synthetic compounds; it literally means "parts integrated into a whole organism" (Clancy and Kirchermann 1999). The farming system is conceptualized as an organism, in which all the component parts – the soil minerals, organic matter, microorganisms, insects, plants, animals and humans – interact to create a coherent whole (Lampkin 1994). The overall goal of the organic approach is to sustain the integrity of the whole farming system. Lampkin outlines the objectives of organic production as identified by the International Federation of Organic Agricultural Movements (IFOAM) (1994:5):

- protecting the long-term fertility of soils by maintaining organic matter levels, fostering soil biological activity and careful mechanical intervention;
- providing crop nutrients indirectly by using relatively insoluble nutrient sources which are made available to the plant by the action of soil microorganisms;
- nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation, as well as effective recycling of organic materials including crop residues and livestock wastes;
- weed, disease and pest control relying primarily on crop rotations, natural predators, diversity, organic manuring, resistant varieties and limited (preferably minimal) thermal, biological and chemical intervention;
- extensive management of livestock, paying full regard to their evolutionary adaptation, behavioural needs and animal welfare issues with respect to nutrition, housing, health, breeding and rearing;
- careful attention to the impact of the farming system on the wider environment so as to conserve wildlife populations and natural habitat;
- maintain the genetic diversity of the agricultural system and its surrounding;
- to allow everyone involved in organic production and processing a quality of life conforming to the UN human rights charter;
- to progress toward an entire production, processing and distribution chain which is both socially just and ecologically responsible.

The key characteristic that distinguishes organic farming from other approaches to sustainable agriculture is the existence of both legislated and voluntary standards and certification procedures, which began to be established internationally and nationally during the 1970s (Lampkin 1994). At the present
time, several countries have developed specific national standards to which all certifying agencies working within that country must conform. France was the first European country to introduce national standards in 1980. In 1993, a set of organic standards was established for all countries within the European Union (EU). Canadian national organic standards were formalized in June 1999. It is anticipated the United States will finalize their standards by the year 2000.

The development of the Canadian organic standards occurred through an industry-led and government-supported consultative process, known as the Canadian Organic Unity Project (COUP). The standards have been legislated under the Canadian Standards Act and are registered with the International Standards Organization (ISO). The Canadian Organic Advisory Board (COAB) was established to oversee accreditation, certification and adherence to the standards. According to Gordon Hamblin (1999, personal communication), Saskatchewan farmer and President of COAB, the formulation of the standards was a challenging process that took ten years to complete. Most members of the Canadian organic community recognized the need for the establishment of Canadian organic standards. The EU, Canada's major organic market, had declared that as of July 1, 1999 they would not permit the importation of organic products from countries that did not have internationally recognized national standards and certification in place. Despite this and other valid reasons for a national system of regulating organic agriculture, there was resistance by some individuals and organizations to having a national agency take charge of these duties. Anne Macey of the Canadian Organic Growers Association (COG) also contends that the process progressed slowly as there was "no political will" on the part of government to formulate and approve the national standards and as a result it was "at the bottom of the priority list" for Agriculture Canada (Anne Macey, quoted in The Mirror, October 20, 1994:12). Another complicating factor was that the organic industry (farmers and marketers) wanted to retain control over inspection and certification. They made the claim that an industry-centered approach (as opposed to the traditional government regulatory agency) was necessary in order to be responsive to the local variability in production and marketing that is characteristic of organic agriculture (The Mirror, October 20, 1994:12). Eventually consensus was reached by all the stakeholders and the Canadian organic standards were finalized within the EU deadline.

used to circumvent rather than to work with the natural system.
Government funding has been provided to COAB to begin the task of overseeing regulation according to the standards established.

Tate (1994) contends that organic regulation has been a key element in the development of organic agriculture.

It is necessary to maintain the high ethical standards of the organic movement, to retain consumer confidence in produce, to encourage and support organic farmers, and to provide a basis for trade of organic products (Tate 1994: 15).

However, regulation is seen by some farmers as costly and time consuming. If application to a particular certification agency is accepted, the farmer must then go through a conversion period that ranges from one to seven years.12 The farmer must meet certification requirements during the conversion or transition period but is not allowed to sell agricultural products in the organic market until certification is complete. The cost of certification varies depending on the agency, but generally includes a base fee with an additional cost per acre certified. Extensive paperwork is also required. Despite the difficulties associated with transition and certification, there are definite economic incentives to become certified as organic products generally draw premium prices. Prices of organic products fluctuate, depending on conventional prices and market demand, but generally range from 30 to 300 percent above conventional prices (Rutherford et al., 1992, Stewart 1997). Production costs can be expected to drop from 20 to 60 percent, depending on the production system. Yields may be lower in organic systems, particularly during the transition period, but this is dependent on various aspects of the farming system (Padel and Lampkin 1994).

The productivity of organic farms is one of the most controversial issues with respect to the viability of organic agriculture (Padel and Lampkin 1994). Critics of organic agriculture argue that there would be a major decline in overall agricultural productivity, limiting food supplies for a rapidly growing world population, if there were a major shift to organic production. Earl Butz, the former United States Secretary of Agriculture, had this comment about organic agriculture (Butz 1971):

We can go back to organic agriculture in this country if we must – we know how to do it. However, before we move in that direction, someone must decide which 50 million of our people will starve.

12. In Saskatchewan all certification agencies require either a three- or a four-year transition period.
Dennis Avery, Director of the Hudson Institute in the United States, claims that to compensate for the loss of productivity with large-scale transition to organic agriculture, "there would have to be a doubling of the world's current cropland - and a plowing down of six million square miles of wildlife habitat" (Avery 1997: 13).

Organic agriculture was a valid nineteenth century response to the problem of the worn out farm. In the modern era organic farming has too often become a religion instead of a production system" (Avery 1997: 12).

Padel and Lampkin (1994) argue that given the evidence available, critics of organic agriculture often exaggerate losses in productivity associated with organic agriculture. The actual outcome depends on whether organic farming is seen as a “do nothing” approach, or as a redesigned system with biological and cultural methods substituting for a reliance on agrochemicals. Lampkin (1994) emphasizes that the key issue when comparing organic with other approaches is that organic farming gives rise to a completely different system and is not a modification of conventional practice.

Organic farmers conceptualize the farm as a living organic whole, or an agroecosystem....It is a case of the whole being greater than the sum of its parts. Thus it may be difficult to reach definitive conclusions about the functioning of an organic agroecosystem based on an analysis of its components without some form of study of the systems as a whole. Traditional agricultural research methodologies - involving the manipulation, quantification and comparison of a restricted number of variables - are inappropriate in a systems context, where a large number of variables are involved and where restrictions on individual variables might impact on overall system performance. Organic farming does not represent the zero-input treatment in a conventional fertilizer or pesticide input trial. For example, the prohibition of synthetic nitrogen in organic farming and the emphasis instead on biological nitrogen fixation, represents a shift to a different production curve, not a shift along an existing conventional one to the zero nitrogen input level (Lampkin 1994: 28, 31).

In a review of comparative studies of organic and conventional farming systems from around the world, Stanhill (1990) concluded that most organic farmers actively manage soil fertility, pests and diseases, and that their yields are quite similar or only somewhat lower than conventional counterparts. In this review, average organic yields were 91 percent of the conventional counterparts. In 30 percent of the comparisons, organic yields exceeded conventional yields. Other studies in Canada and the United States have also provided similar findings (Anderson 1995, Bird et al. 1995, Rutherford et al. 1992, Smith et al. 1990, Stonehouse et al. 1993, Smolik et al. 1993).

The profitability of organic farming systems has also been examined. Rutherford et al. (1992) found production costs to be lower on organic farms in Saskatchewan and that economic returns on
organic farms were similar to conventional farms without premium prices, and were higher when premium prices were obtained for organic commodities. Long-term comparative studies of organic and conventional farming systems have been carried out at the Rodale Institute in Pennsylvania. Hanson et al. (1997) analyzed the economic performance of conventional and organic grain rotations. They found the organic system performed poorly during the transition period, but in the years following transition it was similar to or more profitable than conventional systems, depending on the type of economic analysis. Lockeretz and Madden (1987) compared debt load among a number of organic and conventional farmers in the Midwestern United States and found organic farmers to be under less financial stress. According to Bateman (1994), higher crop and livestock diversity in organic farming systems creates more income stability than is found in more specialized farming systems. With greater diversity, production costs, labour requirements and income are spread more evenly throughout the year in organic farming systems and risk associated with crop failure or rapid shifts in market prices is also lower. Lower input costs in organic systems means lower operating costs because a farmer with lower costs needs to borrow less money. Therefore, less money is spent on interest costs.

In traditional economic analysis of farming systems, the environmental and social costs (the external costs) associated with different approaches to production are excluded from the analysis. Alternative methods of analysis are being used to calculate these external costs of production. In a comprehensive study of farming systems in South Dakota, organic farms were found to have the lowest external environmental impact (Smolik et al. 1993). Painter et al. (1995) compared the economic performance and environment impacts of alternative rotations in the Palouse region of Washington and found the organic rotations outperformed other types of management. Similar findings were reported by Reganold et al. (1993), following a comparative study of biodynamic and conventional farms in New Zealand. In an examination of the social costs associated with different farming practices in the United States mid-west, Flora (1995) identifies ways in which low-input and organic agriculture increases social capital and therefore contributes to the sustainability of family farms and rural communities.  

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13. Social capital is defined as the “information, trust, and norms of reciprocity inherent in one’s social networks” (Wall et al. 1998: 304).
Although these and other studies have provided evidence that organic farming can be a productive, profitable and resource-conserving approach to farming, limitations in this approach have been identified. Rutherford et al. (1992) found that available soil phosphorus was below recommended levels on the organic farms they studied in Saskatchewan. It was suggested in this report that organic farmers monitor soil fertility with regular soil testing and that rock phosphate (which is allowed in organic systems) be used to compensate for phosphorus deficiencies. Soil erosion and reduced soil quality are potential problems for organic farming systems in the Canadian Prairie, as most of the organic farmers continue to rely on tillage and summerfallowing for weed control. There is also a dependency on export markets, for premium organic prices, by most organic producers in the northern Great Plains. The long-term sustainability of this situation is questionable considering the volatility of commodity markets and the energy costs associated with long-distance transportation.

3.4.1.1 Production Trends

During the past three decades, organic production has been steadily increasing in many countries due to identification of socio-economic and environmental benefits associated with this alternative approach. In some European countries, such as Denmark, Sweden, Switzerland, Austria and Germany, governments have introduced financial incentives to encourage more farmers to make the transition to organic agriculture (Lampkin 1994). This support has contributed to rapid expansion of organic production in the European Union (EU) in recent years (Figures 3.2 and 3.3). China has also identified organic agriculture as a high priority, and Cuba is now almost entirely organic (Rosset 1998). Yet, relative to the conventional food system in much of the world, organic production still constitutes a small sector. It represents less than one percent of the agricultural industry in most countries (Lampkin 1994, Orton 1998).

In Canada, accurate identification of the number of organic producers and the size of production has been hampered by various factors. The agricultural census data has not included this type of information and there has been no other comprehensive national or provincial registry of the organic sector. It is anticipated, however, that some form of official registry will soon be put in place (Gordon
Hamblin, personal communication 1999). Obtaining accurate statistics is further complicated by the fact that some organic farmers are registered with more than one certification agency and others choose not to become certified (Henning 1994). Perhaps as a result of these difficulties, there have been few published reports providing statistical information on the Canadian organic sector.

In 1996, the Canadian Organic Growers (COG) identified 1724 certified organic producers in Canada, based on a mail-out survey to provincial certifying agencies (Macey 1996). According to this survey, Quebec had the highest provincial number of organic growers, with 501 producers, followed by Saskatchewan with 365 growers. The Saskatchewan Wheat Pool also conducted a survey in Saskatchewan in 1996 and identified 404 organic growers with a total of 213,320 acres certified organic and an average farm size of 963 acres (Dwayne Basandowski, personal communication 1998). In 1997, the Organic Products Information Service (OPIS) of the Saskatchewan Research Council (SRC) identified 386 organic growers in Saskatchewan with a total of 240,632 acres certified (Mark Gimby, personal communication 1998). According to the OPIS study, 69 percent of the total organic production in Western Canada takes place in Saskatchewan.

Figure 3.2 Growth of Organic Farming in the EU (million hectares) 1985-1998.
(Source: Fowler and Lampkin 1999)
Figure 3.3 Growth of Organic Farming in the EU 1993-1998 (% Total Agricultural Area)
(Source: Fowler and Lampkin 1999)

In a 1990 survey of organic producers in Saskatchewan, most of the farmers identified environmental concerns as being the most important factor influencing their transition to organic agriculture (Green 1990). Economic considerations - lower input costs and premium prices - were of secondary importance to farmers at the time of this survey. The third most common issue identified in the 1990 survey was the effect of agrochemical use on the farm family, their community and on consumers. Additional and less commonly identified reasons for choosing this alternative approach were social and religious convictions, self-reliance and resistance to corporate control over agriculture, and contributing to a locally based food system.

For most organic farmers in Saskatchewan, learning has occurred through various informal means, including other farmers, information from the alternative agriculture press, certification and marketing organizations, and field days and workshops (Green 1990, Smith 1994). Knowledge is mainly developed by farmers conducting on-farm experiments, although information may be gathered from other external sources. Lack of accessible information and support from research and extension have been identified as some of the major hindrances to organic farmers and those wanting to make the transition (Green 1990, MacRae et al. 1989, Smith 1994).
Organic production in most regions of the world is associated with relatively small-scale diversified operations (Lampkin 1994, Coomes and Campbell 1998, Tovey 1997). In Saskatchewan, the majority of organic farms are large-scale producers of cereals, pulses and oilseed crops. According to Stewart (1997) more than 100,000 tonnes of organic grains, seeds and specialty crops were produced in Western Canada in 1997, with Saskatchewan being the largest contributor. Some organic farms combine livestock and crop production, but at the present time there is no organic certification of meat production or processing in the Province. There are only a few organic producers in Saskatchewan growing horticultural crops. Due to the scale of organic farms in the Province, Saskatchewan has been identified as the largest organic acreage of any comparable sized region in the world (Neil Strayer, personal communication 1999). Organic farmers in Saskatchewan have pioneered in adapting the organic approach to large-scale production within an area of high agricultural risk. Saskatchewan's semi-arid and sub-temperate climate limits the variety of crops that can be grown. Diversity in crop rotation is a critical component of organic systems, for weed and disease control and for improving soil quality. This need for diversity in organic cropping systems may be an important factor influencing the distribution of organic farms in Saskatchewan throughout the soil climatic zones (SCZ). According to a 1996 survey conducted by the Saskatchewan Wheat Pool, the largest number of organic producers in Saskatchewan were located the Black and Moist Dark Brown soil climatic zones, which have a combination of relatively high available moisture and a long growing season. The fewest organic farms were located in the Grey and Dry Brown SCZs.

3.4.1.2 Marketing Trends

In most regions of the world, demand for organic products continues to exceed supply. The EU is the world’s leading market for organic food. In 1997, three percent of the food trade in the EU was organic and it was expected that this percentage would double or even triple over the next few years (Tovey 1997). Although production is rapidly expanding throughout the EU, a considerable amount of the food is imported. High quality organic cereals and grains from the Canadian Prairie are in high demand as the Europeans view this region as a relatively unpolluted environment, compared to other industrialized
countries, and therefore an ideal source of organic food (Neil Strayer, personal communication 1998). In North America, the sale of organic food represents one percent of the total food sales and is increasing at a rate of 20 percent per year (Buck et al. 1997). In Canada, sales of organic products in 1998 were estimated at one billion dollars (Hoyle 1999). Market surveys indicate that most of the demand for organic food is from relatively young individuals and families in large urban centers with above average incomes (Stewart 1997, Orton 1998). Stewart (1997) states that increasing demand for organic food is driven by a change in eating habits, as consumers are putting greater emphasis on healthy, nutritious and safe foods. There is also growing support for the development of an environmentally and socially sustainable agricultural system.

Until the late 1980s, major agribusiness firms did not show much interest in organic agriculture in North America (Stewart 1997, Buck et al. 1997). As market surveys began to identify organic as the fastest growing sector of the agrifood system, large corporate players entered the organic field at various levels (Buck et al., 1997, Rosset and Altieri 1997). Buck et al. (1997) report on the proliferation of corporate-run, large-scale organic production in the United States vegetable and fruit sector, particularly in California. These corporate operations “follow the organic rules regulating the use of inputs, but otherwise employ an industrial approach to produce high value high turn-over crops” (Buck et al. 1997:11). Corporate-style organic production is not a significant trend in other regions in the United States or in Canada. Agribusiness corporations are, however, indirectly involved in organic production on a much larger scale through the manufacturing and marketing of inputs used in organic production (including biological control agents, compost, rock phosphate and other soil amendments). Corporate involvement is also becoming more visible in the marketing of organic products. Organic products were initially available only through small independent and cooperative organic and health food stores. While these outlets have continued to prosper and proliferate, there has also been development and consolidation of the health food supermarket sector in large urban centers, as well as the increasing availability of organic products in conventional supermarkets. Throughout the United States, major supermarkets now have organic food sections (Buck et al. 1997).
3.4.1.3 History

Tate (1994) summarizes the historical development of organic agriculture in three main phases. The period of establishment, from the 1920s to 1970, was when core works were written. During this time, most of the agricultural community and society in general disregarded these works as unscientific or regressive, and in some cases advocates were treated with hostility.\(^{14}\) In the second period, between 1970 and 1990, there was a renewed interest in organic agriculture and in many countries organic agriculture acquired a noticeable following. Farmers began turning to organic agriculture as a solution to problems associated with conventional agriculture, including: increasing dependence on non-renewable energy supplies, increasing cost of industrial inputs, increasing consolidation and declining number of farmers and rural communities, pesticide resistance, declining soil productivity despite increased use of fertilizers, agrochemical pollution of ground and surface waters, and the effects of agrochemical contaminants on wildlife and human health. Organic regulations and symbols were being established nationally and internationally. Retail outlets began supplying organic food to a small but growing number of consumers looking for a “greener” alternative to conventionally grown food. In the third period, from 1990 to the present, organic agriculture has gained significant ground. It is now widely recognized as a viable alternative in agricultural production and has become the fastest growing sector of the global food system. Organic agriculture is now also identified as part of a social movement that is challenging the ideological and methodological basis of the dominant industrial model of development. Buck et al. characterize organic agriculture as “one of the frontiers of the new environmentalism, where concerns about food safety, land use and social justice have converged into a politics of relocalization” (Buck et al. 1997: 5).

Organic agriculture has been shaped by the contributions of a number of different individuals and organizations (Tate 1994). Rudolf Steiner of Austria is credited as the founder of the organic approach to agriculture. In 1924, Steiner published a book, based on a series of public lectures, in which he linked the increasing reliance on a reductionist approach to agriculture science and the use of agrochemicals with declining soil quality and animal health. Steiner developed a model for a more integrated holistic approach to the study and practice of agriculture that eliminated the need for agrochemical use by

\(^{14}\) According to Peter and Ghesquiere (1988), organic agriculture was banned in Germany by the Nazis
utilizing and enhancing the relationships between biophysical constituents in nature. Steiner’s work formed the basis of the biodynamic approach and also stimulated other developments in the theory and practice of organic agriculture. In England, notable contributions were made by Sir George Stapledon on alternate husbandry systems, Sir Albert Howard on the role of soil organic matter, and Lady Eve Balfour who emphasized the relationships between healthy soils, crops and human health and was the driving force behind the establishment of the Soil Association, Britain’s leading organic organization. In 1946, Dr. Hans Muller founded a movement for agricultural reform in Switzerland that promoted organic-biological production and direct marketing to consumers as ways to achieve land stewardship and the preservation of family farms. In 1970, practitioners of Muller’s farming and marketing techniques formed Bioland, an organization that represents the largest number of certified organic producers in Europe (Tate 1994). In the United States, J.I. Rodale and his son Robert Rodale popularized organic farming ideas through the magazine Organic Gardening, and established the Rodale Institute, which pioneered research on organic agriculture in North America in the 1970s. In Canada, Dr. Stuart Hill established the Ecological Agriculture Projects (EAP) at McGill University during the early 1970s, and it has continued to be an important information service for those interested in organic agriculture across Canada for nearly three decades.

In Saskatchewan, a few farmers began experimenting with organic agriculture in the 1960s. In the early 1970s, a series of discussion groups on organic and biodynamic agriculture was organized by Paul Hanley (an organic gardener) and coordinated through the Extension Division at the University of Regina and St. Peter’s College at Muenster, Saskatchewan (Paul Hanley, personal communication 1997). The series, called Earthcare, became an important forum for farmers and others interested in exploring alternatives in agriculture. In the late 1970s, Earthcare, the organization, was formed and a grant of $10,000 was obtained from the Saskatchewan Departments of Agriculture and the Environment that assisted in the development of a resource center, publication of a newsletter and the initiation of a
series of conferences that ran from 1977 to 1986. Hanley was the coordinator of Earthcare activities. Within a short period of time Earthcare membership expanded to 500, and included farmers, gardeners, researchers, representatives from government and farm organizations (e.g., the National Farmers Union, the Back to the Farm Research Foundation), and other interested individuals. Hanley commented on Earthcare’s success:

Earthcare created a space where people could discuss controversial subjects in agriculture. Even some of the experts and professionals enjoyed the opportunity and attended the conferences. Earthcare also provided people with a sense of community. Many of these people felt isolated or marginalized (within mainstream culture or institutions) because of their interests and ideas....Earthcare was a diverse community, consisting of individuals with a wide range of opinions and backgrounds. Some people were interested because of environmental concerns. Others became interested because of their concerns about social issues in agriculture, particularly the effects of increasing corporate involvement in agriculture on family farms and rural communities. Some could be characterized as innovators or free-thinkers who liked to explore new and challenging ideas and approaches. A minority was interested because of religious beliefs and commitments (Hanley, personal communication 1997).

Proceedings of the six conferences organized by Earthcare were published by the Extension Division of the University of Regina. With financial assistance from the Saskatchewan Department of Agriculture, Paul Hanley and Robert Morrison (a crop production scientist) co-authored Earthcare: Ecological Agriculture in Saskatchewan, the first book to translate information on the practice of organic agriculture for the Canadian Prairies (Hanley and Morrison 1980). The book was also unique in that it combined reports on scientific research, farm profiles and anecdotal information. The book sold over 27,000 copies in Canada and abroad, including Africa, Asia, the Soviet Union and the United States. New Farm magazine, a publication of the Rodale Institute, called it the best book ever written on organic agriculture.

Despite the success of Earthcare and its activities, changes that began in the mid-1980s eventually brought the organization to an end. Interest and involvement of many of the organic farmers began to wane as their attention turned to the development of marketing and processing opportunities. Hanley was also of the opinion that increasing polarization of certain key members over ideological issues created conflict and tension within the organization. This effected the tone and content of the conferences, which he believed contributed to declining attendance. Finally, with a change in the provincial

16. Hanley credits Frank Harris from Saskatchewan Agriculture as being instrumental in obtaining
government in 1986, from the New Democrats to the Conservatives, government funding and support for Earthcare was withdrawn. By the late 1980s, the organization had ceased to exist.

Earthcare established an important base of information and support for people interested in organic agriculture on the prairies. Those who pioneered organic production in Saskatchewan played a central role in this development. It was only through the interest and involvement of a few key individuals working within mainstream institutions, however, that funding was obtained. Institutional resources were accessed that facilitated the achievement of some major accomplishments within a short period of time. Although the institutional support could not be sustained, the achievements of Earthcare inspired individuals and other organizations to initiate activities that have also shaped the development of organic agriculture in Saskatchewan. Earthcare is credited with having influenced a number of farmers and gardeners in Saskatchewan to adopt the organic approach (Will Oddie, personal communication 1997). Members of Earthcare went on to establish the Organic Producers Marketing Cooperative at Girvin, Saskatchewan (1983-1992), the largest organic cooperative in Canada during that time (Elmer Laird, personal communication 1995). The Girvin cooperative played an important role in the establishment of organic crop insurance in Saskatchewan in 1989. Also in 1989, Gary Smith and Wilma Groenen began co-editing and publishing *Synergy* magazine, covering topics related to organic production on the prairies.

In 1992, the Saskatchewan Organic Development Council (now known as the Saskatchewan Organic Directorate (SOD)) was formed as an umbrella organization to represent organic farmers, traders and other interested individuals. SODC published a newsletter and hosted a series of conferences in the early to mid 1990s. Researchers at the Saskatchewan Research Council (SRC) began investigating organic systems in the late 1970s and reported their findings at Earthcare conferences (e.g., Coxworth and Thompson 1978). The SRC studies culminated in a three-year agronomic and economic investigation of the *Viability of Organic Farm Practices in Saskatchewan*, the first comprehensive study of organic farming systems on the Canadian Prairie (Rutherford et al. 1992).

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provincial funding for Earthcare.
3.5 Summary

Sustainability has become a powerful symbol for a new vision of global development. Despite its widespread appeal and usage during the past ten years, the definition and goals of sustainability have remained controversial and unresolved topics. The conflicts over meaning and methodology, within the context of dominant and alternative paradigms of agricultural development, have been examined in this chapter. The developments of zero tillage and organic farming have been linked to the ideologies, goals and approaches of these two competing social paradigms. Both of these alternative farming practices began to be adopted by a small number of farmers in Saskatchewan during the late 1960s and early 1970s, in response to problems they identified with conventional agriculture. However, the problems that were identified and the responses to them differed significantly for these two groups of innovative farmers, which in turn have influenced the divergent evolution of these practices within the discourse on sustainable agriculture. Farmers’ adoption of zero tillage and organic farming in Saskatchewan were, therefore, based upon very different analyses of the problems in agriculture, and the development of these practices have involved very different networks of actors and relationships.

Some farmers identified soil erosion and declining soil quality as the major problems, and the strategy was to reduce the frequency and intensity of tillage operations. Advances in agrochemicals and farm equipment were needed to achieve this goal. Thus, relationships were formed between farmers, agribusiness firms, and agricultural scientists interested in developing reduced tillage technologies and techniques suited to Prairie conditions. These networks and technical advances also facilitated the repositioning of zero tillage from the margins into the mainstream model of environmental sustainability and increased productivity.

For other farmers, increased dependence on industrial inputs (particularly synthetic fertilizers and pesticides) was identified as the major threat to environmental and human health, and as contributing to the increasing capitalization of farming and farmers’ loss of control over production processes. The organic approach offered these farmers an opportunity to lower their input costs, regain greater autonomy over management decisions, and to reduce the health and environmental risks associated with agrochemical contaminants. In choosing this path of resistance, these farmers have distanced themselves
from a major part of the agribusiness sector and from agricultural institutions, both of which predominantly support high external-input approaches as the most effective ways to improve production output and efficiency. As a low external-input approach and as a form of resistance to the industrialization of agriculture, organic agriculture has, however, been promoted by proponents of an alternative model for agricultural sustainability.
CHAPTER FOUR: THE FARM INTERVIEWS I: CHARACTERISTICS OF THE FARMERS AND THE FARMING SYSTEMS

4.1 Introduction

The preceding chapters provide a broad analysis of the historical context within which conventional agriculture evolved in Saskatchewan, and of the contemporary social forces shaping theoretical and practical approaches to sustainable agriculture. In this and the following two chapters the analysis is focused on local responses to sustainable agriculture that are being developed by zero tillage and organic farmers in Saskatchewan. The data presented in these chapters are derived from interviews with individuals from 33 zero tillage and 33 organic farming enterprises situated throughout Saskatchewan's seven soil climatic zones (SCZs). Quantitative and qualitative approaches were used to gather and evaluate the data in order to gain a richer understanding of farmers' management decisions and their perceptions of sustainable agriculture. I begin this chapter with summaries of six (three zero tillage, three organic) selected interviews (Section 4.2). In the following sections (4.3 and 4.4), quantitative analysis of the characteristics of the farmers and their farming systems are presented. Factors influencing farmers' adoption of an alternative farming practice, and their goals and perceptions about sustainable agriculture and the future of farming in Saskatchewan are examined in Chapter Five. In Chapter Six I evaluate zero tillage and organic farming as local responses to sustainability.

4.2 Stories From the Field

In this section a case approach is used to provide an overview of some of the stories told by farmers about themselves and their families, their farming systems, the factors influencing their decisions, and their perceptions of sustainable agriculture. This approach also provides a good starting point for examining the differences and similarities between and within categories of farming systems. When I first decided that it was important to include some stories from the field I did not have a specific
number in mind. It seemed appropriate to incorporate those that would represent the key themes that emerged from the interviews. Case after case was added to the list and by the fourteenth I finally acknowledged it was impossible to select a small representative number to fulfil this objective. Each story was unique and important. This richness and diversity has held my interest from the time of the interviews through the many times I have read over the transcripts. But diversity is difficult to package. The approach I took was to limit this section to six stories, three from organic farming systems and three from zero tillage farming systems located in each of the major soil zones (Grey, Black, Brown). The summaries presented here do not encompass all the important points that were raised during the interviews, nor can they provide the reader with a complete picture of the people and places they represent. They are, however, an introduction to the unique and complex set of factors that constitute and shape farming systems. In order to maintain the anonymity of the farmers interviewed I have not used their real names.

4.2.1 Three Organic Farming Systems

Organic farming systems in the northern Great Plains have not been extensively researched, but there are many commonly held assumptions about organic producers and their approach to farming (Smolik et al. 1993). Many people I spoke with during the course of this research, excluding those from organic farms, believed that organic farms were smaller than average, less economically viable, with lower yields, inferior soil quality and weeds growing everywhere. Organic farmers were often perceived as “hippies” or “back-to-the-landers”, “religious kooks” with unfounded phobias about agrochemicals, or just plain bad farmers. These characterizations do not accurately describe most of the farmers or farming systems investigated here. For example, although there was a wide range of farm sizes in the study sample, the average size of the organic farms was larger than the provincial average and the largest farming operation examined in this study was organic. Also, spiritual and philosophical factors were not considered to be as important by the majority of the organic farmers interviewed as were environmental, health and economic factors in influencing their selection of farming practice. These and other characteristics examined suggest that there is much to be learned about organic farming systems in
Saskatchewan. Even though organic farmers represent only a small portion of the total number of farmers in Saskatchewan, they are a diverse group of people using a variety of strategies to develop viable farming systems.

4.2.1.1 In the Grey Soil Climatic Zone

Ken and Irene farm 1920 acres (1600 acres owned, 320 acres rented) in the Grey SCZ.¹ They have been farming organically since 1981 and were fully certified for organic crop production by the Organic Crop Improvement Association (OCIA) in 1986. Their farm is a diversified operation, including a variety of crops, 300 cows and calves, and an organic grain cleaning facility. In addition to managing the farm and the cleaning facility, Ken also does some marketing of organic grains. The domestic and childcare duties (8 children under the age of 10) are Irene’s primary responsibilities. They hire three full-time employees, one to help out with the farm work and two to work in the cleaning plant.

Crop production on this farm revolves around a five-year rotation, including flax, cereals, peas, oats, and a legume green manure crop. Summerfallowing has been eliminated and conservation tillage methods are used in order to retain crop residue on the soil surface. Fields are tilled prior to seeding and cereal crops are harrowed soon after the crops emerge. Legume green manure crops are cut and worked under in early July. In addition to using legumes in rotation to improve soil fertility, Ken also spreads livestock manure on the fields.

Ken said it was a combination of environmental, economic, health and philosophical factors that influenced him to make the transition to organic farming. He was not certain just how he first heard of organic farming, but he remembers spending a lot of time researching and reading about it during the mid to late 1970s. He became involved with organic and sustainable agriculture organizations in the northern United States and met a number of organic farmers and other individuals that had a significant influence on his transition to organic farming. Farming organically seemed to him like more fun and more of a challenge. An organic approach to farming also seemed to make more sense than conventional farming when he considered the cost of agrochemicals and their risk to the environment and to his and his family’s

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¹ This interview was conducted with Ken by telephone.
health. Ken also felt that organic agriculture, by eliminating the use of agrochemicals and reducing dependence on other technologies, was a form of resistance to the increasing control of agribusinesses in agriculture. He was adamant that organic farmers retain control over production and marketing.

Ken identified the need for further research on organic systems, but said that farmers were going to have to contribute funding, through a check-off, if they wanted to see it happen. He was critical of the influence of agribusinesses over provincial and federal agricultural institutions.

I don't have much use for Agriculture Canada or the College of Agriculture. They promote the interests of the multinationals - herbicides and biotechnology. The multinationals have control throughout the system now. Farmers take all the risks and the companies take all the profits.

Despite the lack of institutional support, Ken felt more farmers in the province were becoming interested in organic agriculture. He thought the three-year certification period might, however, discourage some from actually making a commitment. Within his area, many more farmers were moving to a zero tillage system.

Less tillage is the right way to go, but it should involve more forages and plough downs, not more chemicals. The big promotion of zero till in the province is brainwashing farmers to invest in more agrochemicals and new and bigger equipment.

Ken said he was hopeful that the farm would stay in the family, but as his children were still young it was difficult to know for certain. Although he and his wife were working hard to try to create a sustainable farming operation to support their family, he was not optimistic about the future of family farms. He felt the trend to larger and fewer farms was not sustaining family farms or rural communities, and that bigger farms were not more efficient. For Ken sustainable agriculture is about more than sustainable farming, it is a way of life. It's when the whole agricultural system works together for the next generation.

4.2.1.2 In the Moist Black Soil Climatic Zone

Bob and Annette own and operate a 1200 acre farm in the Moist Black SCZ. They began farming organically in 1976, before certification agencies were established in the province. They were first certified by an out of province agency, and then by a local OCIA chapter in 1988. It is a single

2. Both Annette and Bob took part in the interview at their farm.
family operation, with Annette and Bob contributing equally to the farm work. Their two children, ages seven and ten, are too young to take an active role in the farming operation. In the summer they hire two full-time employees to help with farming and with an on-farm business involving the production and packaging of seeds for sprouting mixes.

Bob obtained a Bachelor of Science degree in Biology and Annette completed two years of an undergraduate degree in Agriculture before they decided to return to the family farm. They decided to farm with minimal use of agrochemicals due to their concerns about associated environmental and health risks. After farming a few years with this low-input approach, they discovered there were good prices for organic products which influenced their decision to eliminate farm chemicals from their operation. Annette said they were philosophically happier adopting an organic approach to farming and would rather eat organically produced food. She added that economic factors, however, played a crucial role in their decision-making and they might not have made the commitment to organic production if they had not found markets for their products.

Over the years they have obtained information from a variety of sources, including magazines, meetings, field days, other organic farmers, organic and sustainable agriculture organizations, provincial and federal agricultural research institutions, and their own trials and errors. They believe interest and support for organic agriculture has increased significantly in the province over the past twenty years. They have witnessed a real turn-around in the attitude of local farmers, shifting from scepticism to a positive interest in organic agriculture. Their local OCIA chapter is growing steadily and they felt support from provincial and federal agricultural agencies has been steadily increasing.

A variable five-year crop rotation is used on this farm, involving various combinations of the following crops: fall rye, winter triticale, oats, spelt, quinoa, buckwheat, alfalfa, radish, and cress. The rotation ends with summerfallow. They pay a lot of attention to the design of their rotations as they believe they are key to improving soil quality and controlling weeds, diseases and pest infestations. In addition to the incorporation of nitrogen-fixing legumes in rotation, they have also used rock phosphate, gypsum and borax to compensate for deficiencies detected by regular soil tests.
The farm couple has been involved in research projects with Agriculture Canada, the Saskatchewan Research Council and the College of Agriculture. They are also actively involved in their children’s school-related activities and other community organizations, as well as provincial and international organic organizations.

Annette and Bob identified several goals for the future, including farming fewer acres more intensively, further developing their marketing of organic products, and achieving a higher and more stable income. They would also like to be able to travel and holiday more with their children, and retire early.

“Sustainable agriculture,” said Annette, “means taking care of the land.” Bob added:

It’s about more than minimizing soil erosion or improving soil fertility through the use of Roundup and other chemicals, it’s about taking account of the whole picture. We should also be working towards closing the urban and rural gap. It will require a lot of changes.

4.2.1.3 In the Dark Brown Soil Climatic Zone

Frank, Rita and their two sons, Doug and Steven, own and operate a 4320 acre organic farming operation in the Dark Brown SC-Z. The farm is specialized in crop production, but they also operate a cleaning and processing plant on the farm and market all of their own products. Each member of the family takes an active role in different parts of the operation. Rita is primarily responsible for marketing, whereas Frank, Doug and Steven deal with production and processing. They emphasized the importance of everyone’s talent and input to the success of their operation. Frank said that Rita’s marketing abilities, in particular, has been vital to their economic success.

Frank said that from the time he started farming, during the early 1960s, he had concerns about environmental and health effects associated with pesticides and tried to limit the use of them. By the early 1980s, Frank and Rita were seriously considering converting to organic management and in 1985 they began certification through OCIA.

Developing diversified and extended rotations has been their major focus for improving soil quality and weed control. Rotations are four or five years in length and with variable crop composition,

3. The four members of the family taking part in the farming operation were present during the farm
depending on climatic and market conditions. Major crops used in rotation include cereals (hard wheat, triticale, durum, rye, spelt), flax, millet, and sunflowers. Instead of summerfallowing they use a sweet clover plow down crop. By underseeding with clover they have also been able to decrease the need for in-crop cultivation. They have found the allelopathic properties of triticale and rye to also be effective in reducing weed populations. Harrowing is done prior to seeding and shortly after emergence of the seedling. In addition to using nitrogen-fixing legumes in rotation, they also use composted grain screenings and shredded flax straw on their fields. Although they no longer have livestock Steven commented that organic farmers should ideally have a mixed crop and livestock operation.

They are always seeking out information on production, processing and marketing of organic products. Sources of information include conventional and alternative agriculture presses, organic and sustainable agriculture organizations in Canada and the United States, scientific research results, and national and international conferences on organic and sustainable agriculture.

They have been involved in on-farm research projects conducted by the Saskatchewan Research Council and the College of Agriculture. They said they thought that there should be more research on organic farming, but that agrochemical companies were influencing the research being done within agricultural institutions. Their involvement in community organizations has decreased as they have put more time into farm management, processing and marketing.

All the family members said they were committed to organic farming and were proud of what they had accomplished over the past ten years. They post signs in their fields indicating OCIA certified organic crops. They felt interest in organic farming was increasing, particularly from younger farmers, as inputs costs continue to rise. Doug commented:

The future looks better and better for organic farming, not only because of increasing consumer demand, but also because more farmers are starting to see it is a viable option.

For these farm operators sustainable agriculture starts with viable family farms. They acknowledged the importance of meeting economic and environmental criteria and believed they were interview.
working to meet those objectives. They also underlined the central role that nutritious food plays in the
development of healthy and sustainable families and communities. They felt that organic systems play a
key role in developing sustainable agricultural systems. They commented that reducing tillage and
summerfallowing were essential to sustainability of the soil, but that zero tillage systems were
fundamentally flawed due to their increased reliance upon agrochemicals.

4.2.2 Three Zero tillage Farming Systems

Zero tillage and organic farming practices are often presented as far apart in terms of their
objectives and approaches. The findings of this research suggest that there are both similarities and
differences between the two types of farming systems examined here. The following three stories of zero
tillage operations reflect the fact that many zero tillage farmers, like organic farmers, have recognized the
importance of diversified and extended crop rotations and are developing rotations that work within their
systems. Some of the zero tillage farmers interviewed also had concerns, as did many organic farmers,
about the environmental and health effects associated with the use of agrochemicals and said they would
like to find ways to reduce the use of these inputs. Almost all of the farmers interviewed, from both zero
tillage and organic operations, expressed concerns about the declining number of family farms which they
felt were vital to the sustainability of agriculture in Saskatchewan. Other similarities and differences
between and among organic and zero tillage farmers are identified and analyzed in the remaining sections
of this chapter.

4.2.2.1 In the Grey Soil Climatic Zone

George and Helen own and operate a 640 acre farm in the Grey SCZ. Five hundred acres are in
crop production; the remainder is pasture and bush. In addition to farming, they have also developed the
farm into a bed and breakfast, and Helen sells many of the vegetables, fruits and flowers she grows at the
local farmers’ market.

4. Both George and Helen were present when the interview took place, but Helen’s participation was
limited. I was able to talk more with Helen during a tour of her garden.
George uses a four-year crop rotation, involving cereals, legumes, oilseeds, and cereals. The crops grown in rotation include wheat, oats, barley, canola, peas, flax, alfalfa, rye, and winter wheat. For weed control, George relies mainly upon spring burn-off with Roundup, in-crop spraying and fall application of 2,4-D. He is also starting to incorporate fall application of Roundup into his farming practice.

George became interested in conservation tillage in 1978. He always liked to try out new innovations in farming and thought that conservation tillage would improve soil quality and prevent erosion. Shortcomings in the technology and the high cost of suitable herbicides held him back from moving to a zero tillage system until 1989. George has noticed significant economic benefits since moving to a zero tillage system.

Fuel costs are only a third of what they used to be. Fertilizer and chemical costs have remained the same, and I've been able to reduce my investment in machinery. Yields are the same or somewhat better than conventional yields in the area.

Despite these benefits George was not totally committed to zero tillage or any farming practice. He said he was always open to experimentation and change, and would do whatever worked on his farm. He added that the provincial trend of reduced tillage and summerfallowing has been extremely beneficial to soil conservation. He hoped everyone would eventually swing to some form of conservation tillage.

George has gained access to information on zero tillage from a number of sources, including the SSCA, Mandak, Agriculture Canada, the College of Agriculture, and the local agricultural extension agent. He has attended yearly conferences on zero tillage across the prairies. He felt support for zero tillage has been very good in the province and attributes a large part of the success of adoption to the grassroots work of the SSCA and local Agriculture Development and Diversification (ADD) boards.

Helen and George are active members of community organizations. George has also held positions on a number of local and provincial agricultural committees, including a four-year term as an advisor to the Minister of Agriculture. George has also been involved with on-farm zero tillage research projects with Agriculture Canada, and Helen has taken part in fruit and vegetable variety and demonstration trials carried out in conjunction with the Horticulture Department at the College of Agriculture.
George and Helen said that they were certain the farm would not be staying in the family, as their children were established in careers in urban centers. They both enjoyed their lives on the farm and felt it had been a good way to raise a family. Even though they were close to retirement age, George said ideally he would like to buy another 160 acres and stay farming as long as their health permitted. Helen was not as enthusiastic about the idea.

They expressed concern about the future of family farms in Saskatchewan, particularly in the north where they felt transportation was a key issue. George commented on the future of agriculture in Saskatchewan and on the meaning of sustainable agriculture.

I’m losing my optimism about farming. I’ve been farming 41 years, and over the past 10 years there have been more changes than over the previous 30 years. And there are a lot more changes coming. Farmers have to adapt fast. They have to have the resources to adapt. The smaller, less educated farmers are going to lose out.

What is sustainable agriculture? I’m not so sure anymore. I know it’s about leaving the land in better condition, and I think zero tillage has helped that. And it’s helped me economically. But I don’t know if anything can stop all the family farms and rural communities that are going under. If there’s only a few large farms left, is that sustainable? Our policies aren’t supporting the sustainability of rural Saskatchewan.

4.2.2.2 In the Moist Black Soil Climatic Zone

Lyle is one of four family members in a farming enterprise in the Moist Black SCZ.\(^5\) He and one of his brothers are partners along with their parents in a 4200 acre crop production system. They own sixty percent of the land they farm (2520 acres) and rent the remainder (1680 acres). Lyle, his brother and father are the primary farm operators, and they hire custom work for some of the combining and all of the spraying. His mother, two other brothers and their wives provide casual help when it is needed. His mother is mainly responsible for the gardening and domestic work. Lyle emphasized that they all work together as a team, and talk everything over around the kitchen table.

For the past eight years they have used a four-year rotation consisting of canola, wheat, flax and barley. The rotation is always flexible. Weeds are controlled by spring and fall burn off with Roundup and in-crop spraying with various other pesticides.

\(^5\) The interview was conducted with Lyle as the other members of the family were not available.
Lyle said his father was always interested in finding ways to improve the soil and had tried different methods of conservation over the years. In 1988 they began practicing minimum tillage and by 1992 had completed the transition to a zero tillage system. Lyle first read about zero tillage twenty years ago and was very interested even though other farmers in the area told him it would not work. The local reaction didn’t concern him or the rest of his family. They continued to investigate and experiment until they were convinced it could work under their conditions. They continue to read a lot and are not afraid to phone scientists and extension agents for information and advice. They are members of Mandak and regularly attend zero tillage conferences and field days hosted by various organizations. Lyle said adoption of zero tillage has been slow in their area, but that interest and support for zero tillage has really increased in the province in the past 5 years.

Since moving to minimum and zero tillage, they have noticed an improvement in soil quality which they believe has led to better water infiltration and conservation of soil moisture. They have been able to cut down on labour and time in field operations which has made it possible for them to rent more land. Fuel costs are less than half of what they were under conventional management, and by selling off old machinery and equipment they were able to pay for a new air seeder. They have noticed an increase in the use of fertilizers and herbicides, but not to a level they consider unacceptable. So far, yields have not changed significantly.

Lyle said he wants to continue farming and is certain the farm will stay in the family and stay zero till. Their family goal is to achieve a balanced environmental and economic equation for their farm, not to just maximize yields and profits. He made the following comments concerning sustainable agriculture:

I don’t really know what other farmers think about sustainable agriculture. But to me it’s about farming in tune with the land, finding ways to balance the equation, economically and environmentally. Many farmers are more concerned about getting out of debt and surviving. Most people really haven’t really changed the way they farm.

4.2.2.3 In the Moist Dark Brown Soil Climatic Zone

Jim and his wife Susan are part of a large family farm enterprise situated in the Moist Dark Brown SCZ. The operation consists of 5000 acres (4200 acres owned, 800 acres rented) of crop
production and a registered seed business. Jim, his brother and father are the primary farm operators. Susan takes care of the farm accounts and other paper work. She is also responsible for the domestic work and care of their five children. Both Jim and his brother also have other off-farm careers. His brother has a law practice and Jim does carpentry work.

This family was one of the first in the area to practise continuous cropping, minimum tillage and zero tillage. They began conservation tillage management twelve years ago and moved to a zero tillage system six years ago. Their major sources of information and support have been other farmers, Mandak, SSCA, agricultural conferences and conventions, field days, reading, Saskatchewan Wheat Pool and their local agricultural extension agent. Jim said they are now finding a lot of relevant and accessible information available on zero tillage, but the most important source for him was other farmers.

Agriculture is so situational. It's really important to listen to the experiences of other farmers and have an opportunity to have discussions with farmers with similar situations to your own.

"Blowing topsoil" was the major factor influencing their transition to zero till. Jim said there have been significant changes in soil structure and quality under the new management system: "the residue is kept on the surface and the soil is moist right to the top". He also identified changes in labour requirements and in financial aspects:

Although we may not be saving much on fertilizers and pesticides, we're saving on big capital expenditures. The time saved in the field has been converted to time in management. We do a lot of reading and investigating. We're also growing a lot of new crops and felt we should learn the agronomics of growing them. We spend a lot of time walking our fields, looking at the crops. You have to know what's going on. You can't let the custom operators do the work, while you sit inside.

Jim said the weed spectrum had also changed. Winter annuals were decreasing, while buckwheat, wild sunflower and Canada thistle were increasing.

Jim said their crop rotation is being modified as they grow more new crops and learn more about zero tillage systems. Their preference is for a 4-year rotation, consisting of cereals, pulses, cereals, and oilseeds, because it works well for rotation of herbicides. Their selection of crops in rotation is also influenced by market conditions. Weed management consists mainly of spring burn off with Roundup and in crop spraying, and they were also experimenting with surface application of chemicals in the fall. Jim
said they are very conscientious about rotating chemical use because he wants to limit the development of herbicide resistance.

Jim said that zero tillage was “booming” provincially, but resistance from the older generation in his area was inhibiting adoption. He estimated ninety percent of the farmers his age in the area work off-farm. Instead of hiring help, most have their fathers help with the farm and they want to do things the old way. Jim also commented that rural family life was deteriorating as a result of all the off-farm work, but most people, including himself and other members of his family, felt off-farm employment was necessary to sustain a certain standard of living.

We’re all hoping that somewhere down the road things will get better and we can have more time with our families. Meanwhile a lot of us are just treading water.

Jim is a third generation farmer. He said his biggest goal is to have the farm stay in the family and therefore wants to give his children the opportunity to farm. He indicated he would need a reasonable land base to ensure that could happen as he has five children. He is also committed to looking after the land for other generations to follow. He said he was not that concerned about their use of agrochemicals, particularly Roundup, which he felt was extremely safe. He added that if there were other ways to meet their goals and be more environmentally friendly he would do it. Organic agriculture was of interest to Jim for that reason. He said he was following developments in the organic industry by reading and talking with organic farmers. He thought the rotations developed by organic farmers were of benefit to all farmers. The major problem he identified with organic farming was the time and labour requirements that he felt might make it impossible to farm the amount of land they farmed, as well as run the registered seed business.

Jim said he had attended a conference on sustainable agriculture a few years ago, organized by the provincial government. A number of farmers were invited to participate. What became very clear to Jim while he listened to the comments of other farmers was how diverse farming conditions were throughout the province. These are his comments about sustainable agriculture:

The motherhood statement of sustainable agriculture is very general, but to implement it is much more complex because of the diversity of farming conditions. The more grassroots the focus of our efforts, the better in maintaining and working with that diversity. But the more government downsizes to cut costs, the more difficult it will be to stay in touch with that diversity. Also, farmers aren’t receptive to being told what to do. The more personal contact researchers and
policy makers have with farmers the better. It’s better for farmers to see the need to take responsibility for the land than to be forced to do it by bureaucrats.

4.3 Characteristics of the Farmers

The preceding stories of zero tillage and organic farming systems provide an indication of the diversity that existed in the characteristics of the farmers sampled in this study. The results from other studies of alternative farming systems confirm that it is difficult to identify a consistent profile of the farm operators. Surveys in Quebec (Henning 1994) and Saskatchewan (Molder et. al. 1991) found organic farmers to be younger and less experienced than the general farming population. Rusmore (1989) surveyed 188 low-input and organic producers throughout the Northern Plains and Rocky Mountains and found them to be younger but with extensive farming experience. Jamtgaard (1992) found no difference between conventional and organic Montana producers with respect to age, experience or education of the producer. Gould et al. (1989) found that older and more experienced farmers are more likely to be aware of soil erosion, but that younger less experienced and less risk adverse farmers were more likely to adopt conservation tillage practices. Buttel et al. (1990) concluded that minimum or zero tillage is most likely to be adopted by well educated and non-risk adverse farmers who have access to public cost-sharing and conservation information programs. Characteristics of zero tillage and organic farmers taking part in the study are examined and compared in the following sections.

4.3.1 Number and Gender

In this study there were 83 individuals from 66 farming enterprises participating in the farm interviews. Of these, 69 were male and 14 were female (Table 4.1). Spouses, partners and children involved in family farming operations were encouraged to take part in the interviews whenever possible, but in the majority of cases interviews were conducted with the male “head of the household.” Ten of the fourteen women taking part in the interviews (seven from zero tillage enterprises and three from organic enterprises) contributed little or no information about technical aspects of the farming system but became more involved in discussions about goals and perceptions. There were a few opportunities, usually before or after the main interview, to talk one-on-one with some of these women about agricultural issues of
interest or concern to them. Four of the fourteen women interviewed took an active role throughout the interviews. Three of these women were involved in organic family farm operations and one woman was the sole operator of a small organic herb farm.

Table 4.1 Number and Gender of Interviewees from Zero Tillage and Organic Farms in Different SCZs

<table>
<thead>
<tr>
<th>SCZ</th>
<th>Zero Tillage</th>
<th>Organic</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N(farms)</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>Dry Brown</td>
<td>4</td>
<td>4</td>
<td>1†</td>
</tr>
<tr>
<td>Brown</td>
<td>5</td>
<td>5</td>
<td>3†</td>
</tr>
<tr>
<td>Dark Brown</td>
<td>5</td>
<td>5</td>
<td>1†</td>
</tr>
<tr>
<td>Moist Dark Brown</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Black</td>
<td>6</td>
<td>6</td>
<td>1†</td>
</tr>
<tr>
<td>Moist Black</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Grey</td>
<td>3</td>
<td>3</td>
<td>1†</td>
</tr>
<tr>
<td>Totals</td>
<td>33</td>
<td>33</td>
<td>7†</td>
</tr>
</tbody>
</table>

† Individuals were present during the interview but contributed in a minor way.

4.3.2 Age and Marital Status

The ages of the producers who took part in the interviews ranged from 23 to 71. The largest proportion of both zero tillage and organic farmers was 41 to 50 years of age (Figure 4.1). The average ages of the zero tillage operators (44) and the organic farmers (42) were younger than the provincial average age (49) of farm operators (Statistics Canada 1997). For both zero tillage and organic operators, 5 percent were single, 3 percent were divorced, and 92 percent were married with children.
Figure 4.1 Age Distribution of Zero Tillage and Organic Farmers

4.3.3 Years of Farming Experience

Most of the farmers in this study had extensive general farming experience, but zero tillage operators were somewhat more experienced than organic farmers (Figure 4.2). Both zero tillage and organic farmers had significantly less experience with an alternative farming practice (Table 4.2). Seventy-five percent of the zero tillage farmers had ten years or less experience with zero tillage management and only twenty-five had between 11 to 20 years of experience. The organic operators were somewhat more experienced with an alternative approach. Sixty percent had ten years or less experience and 40 percent had 11 to 25 years experience. Those organic farmers with more experience began farming organically in the 1970s and 1980s, before a certification agency was established in the province. Although the majority of the farmers had only ten years or less experience with organic management, all of the farming operations examined in this study had completed organic crop certification. Some of the farms using zero tillage management were still in transition and not all of the farming operation was under zero tillage management.
Figure 4.2 Years of General Farming Experience

Table 4.2 Years in which Transition to an Alternative Farming Practice Began

<table>
<thead>
<tr>
<th>Years of Transition</th>
<th>Zero Tillage</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N(farms)</td>
<td>%</td>
</tr>
<tr>
<td>1995-1990</td>
<td>15</td>
<td>46</td>
</tr>
<tr>
<td>1989-1985</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>1984-1980</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>1979-1975</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Before 1974</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

In the diffusion of innovations model, the early stages of diffusion are characterized by low adoption rates (Rogers 1983, Lampkin and Padel 1994). During the time at which the fieldwork for this research was done (1995-1996) the proportion of organic farmers relative to the total number of farm operators in the province was less than 1.0 percent. Thus, according to the diffusion model, organic farming in Saskatchewan during the mid-1990s was at a very early stage of diffusion. The organic farmers in this sample can therefore be placed in the category of the innovators. Innovators are characterized as individuals who are highly motivated by personal values and goals, are willing to deal with a high level of risk and uncertainty involved in taking an approach or innovation that is relatively unknown and untested (Rogers 1983). According to Padel and Lampkin (1994: 299), when the innovation
and innovators are viewed as a challenge to conventional ideology and approaches, they are initially rejected by the majority. The next stage of diffusion is characterized by the early adopters. They are a more integrated part of the established system and therefore play an important role in making the innovation acceptable in the community. Given that the diffusion of zero tillage was at a more advanced stage than organic farming when this study took place, the zero tillage farmers sampled most likely included both innovators and early adopters.

4.3.4 Post-Secondary Education

In 1996, 20 percent of Canadian male farm operators and 25 percent of the female operators had post-secondary training. Twelve percent of the male operators and 17 percent of the female operators had some university education (Statistics Canada 1997).6

The farm operators surveyed in this study had more formal education than the general farming population in Canada (Table 4.3). Fifteen (35 percent) of the organic operators interviewed had post-secondary training and nine of those (21 percent) had attended university. The majority of those with a university degree had an agriculture related undergraduate degree (Bachelor degrees in Agriculture, Biology or Agricultural Engineering) and two had Vocational Agriculture diplomas. Those with technical training had studied agriculture business, carpentry, welding or massage therapy.

Table 4.3 Number and Percent Distribution of Farmers with Post-Secondary Education

<table>
<thead>
<tr>
<th>Post-Secondary Education</th>
<th>Zero Tillage</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Technical school</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Vocational Agriculture Diploma</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Some university</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Undergraduate university degree</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Graduate university degree</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Totals</td>
<td>10</td>
<td>25</td>
</tr>
</tbody>
</table>
Ten (25 percent) of the zero tillage operators had post-secondary education. Eight (20 percent) had university education, and most of these had agriculture related degrees including two with Bachelor degrees in Agriculture, one with a Bachelor degree in Agricultural Engineering, and one with a Masters degree in Agriculture Economics. Two zero tillage farmers had technical training in Agricultural Mechanics.

4.3.5 Involvement with Formal Agriculture Research, Community and Agriculture Organizations

The extent of people’s participation in local community organizations is often used as an indicator of their commitment or contribution to the vitality and sustainability of their community (Buttimor 1998). Community involvement fosters social and political connections, facilitates access to community resources, and may help maintain kinship ties (e.g., Bennett 1982, Bourdieu 1990, Goreham et al. 1992, Phillips and Gray 1995, Vanclay 1992). Active social participation by residents of rural communities is crucial to the survival and effective functioning of these places especially given the powerful social and economic forces that are undermining their vitality (Goreham et al. 1992). Farmers’ involvement with agricultural organizations and agricultural research institutions establishes broader social and political connections that can increase access to relevant information and expertise (Phillip and Gray 1995, Scoones and Thompson 1994).

Farmers taking part in this study were asked about their involvement in community and agricultural organizations, and their participation in formal agricultural research. The data reveal differences between these two farming populations with regard to their participation (Table 4.4). Zero tillage farmers were more involved than organic farmers in formal agricultural research projects, but participation in community and agricultural organizations was higher for organic farmers.

Forty-two percent of the zero tillage farmers in this study reported involvement with on-farm research projects conducted by federal research institutes (Agriculture Canada and the Prairie Farm Rehabilitation Administration (PFRA), provincial agricultural institutions (the College of Agriculture, the

6. Provincial statistics on the education levels of farmers are not provided in the census of agriculture.
Saskatchewan Department of Agriculture and Food) and agrochemical companies (Monsanto, Zeneca, AgrEvo, Cynamid, DowElanco, Dupont). In contrast, only 27 percent of the organic farmers in this study reported participation in formal research projects, coordinated by Agriculture Canada, the Saskatchewan Research Council (SRC), the College of Agriculture and PECOS (University of Saskatchewan and the University of Regina). Several organic farmers commented that there were few opportunities for them to become involved in formal research. Although it was acknowledged that there was more interest in organic agriculture by the research community in recent years, most commented that there was still a need for significantly more agronomic research relevant to organic systems.

### Table 4.4 Participation of Members of the Farming Operation in Formal Agricultural Research, Community, and Agricultural Organizations

<table>
<thead>
<tr>
<th></th>
<th>Agriculture Research</th>
<th>Community Organizations</th>
<th>Agricultural Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Zero Tillage</td>
<td>14</td>
<td>42</td>
<td>17</td>
</tr>
<tr>
<td>Organic</td>
<td>9</td>
<td>27</td>
<td>21</td>
</tr>
</tbody>
</table>

Participation in agricultural organizations was higher for organic farmers in this study. They all reported involvement with a variety of traditional, organic and sustainable agricultural organizations. The traditional organizations they identified included the Saskatchewan Wheat Pool, the National Farmers' Union, the United Grain Growers Association and the Canadian Wheat Board. The organic and sustainable agriculture organizations they were involved with included OCIA, CROP (a Saskatchewan organic marketing cooperative), Steep Hill Food Coop (an organic retail outlet in Saskatoon), COAB, local conservation clubs, the Saskatchewan Organic Development Council (SODC), Alternative Energy Resource Organization (AERO), and the Northern Plains Sustainable Agriculture Society (NPSAS). A small number of the organic farmers were also members of the Canada World Food Bank and one was a member of the Buffalo Ranchers Association. Zero tillage farmers were involved with similar traditional agricultural organizations (as listed above) and also reported involvement in local soil conservation clubs, the SSCA. Mandak.
The more extensive involvement of the organic farmers in a greater variety of agricultural organizations suggests these farmers are seeking opportunities to access a wider range of information and resources. Many of the organic farmers commented that much of the production and marketing information they need is best obtained through exchange with other farmers and marketers. They felt that both traditional and alternative organizations present opportunities in this regard. Their involvement in organic and sustainable agriculture organizations were also identified as ways for them to increase their knowledge about philosophical, spiritual, ecological, and health issues related to organic and sustainable agriculture. They recognized how important their involvement and contribution was to the existence of these organizations, as there is relatively little support from government or agribusiness sectors for these alternative organizations.

The zero tillage farmers in this study were mainly concerned about accessing information about marketing and production techniques and technologies. Much of the technical information can be readily obtained through local chemical and equipment dealers, scientific and government publications, or by attending local or provincial meetings, conferences and trade shows on zero tillage. Many of these activities have corporate or public sector sponsorship. Farmers’ membership and involvement in zero tillage and soil conservation organizations are, therefore, not as critical to the delivery or accessibility of this information and resources.

Both zero tillage and organic farmers reported involvement with a broad range of local community organizations, such as the Lion’s Club, Elks, sports clubs, schools, churches, community halls, senior citizens and Credit Union boards. Participation was higher for organic farmers, which suggests they are more willing to contribute to local communities. Studies have linked increases in organic and other low-input farming approaches to increased viability of local communities (Bateman 1994, Flora 1995, Lockeretz 1986). According to Lockeretz, farmers using these approaches to sustainability tend to increase their purchases from local businesses and to transfer a greater share of productive value of agricultural resources to local businesses. Flora characterizes these farmers as more philosophically inclined towards “mutual trust and reciprocity, and that is what helps nurture and build social capital within small, agriculturally dependent rural communities” (Flora 1995: 229).
4.4 Characteristics of the Farming Operations

When whole farm systems are examined no two organic or zero tillage operations are identical. There is great diversity in the mix of machinery, rotations, inputs, cultivation, seeding and other practices. The data presented in the following sections illustrates the diversity between and within the two types of farming systems examined.

4.4.1 Organization of the Farm Enterprise and Number of Farm Operators

According to the 1996 census of agriculture, 71 percent of all the farms in Saskatchewan are single operators or family enterprises, 21 percent are operated as partnerships, and eight percent are incorporated family enterprises (Statistics Canada 1997). In comparison to the census data, higher proportions of the farming enterprises examined in this study were traditional family farms, lower proportions were operated as partnerships and no corporate farm enterprises were reported (Table 4.5).

More organic than zero tillage farms were operated as partnerships. Three of these organic enterprises were single generation multifamily partnerships. Unrelated families were involved in two of the partnerships and blood-related families operated the other organic farm partnership. There were also three organic farm partnerships operated between family members of two different generations. One was a partnership between a husband, wife and their two sons, and two were partnerships between three blood-related families of two generations. The zero tillage farm partnerships included one operated by two unrelated families, and three operated by blood related families. The higher number of organic partnerships over zero tillage partnerships in this sample supports findings from other studies that have shown there is an increasing emphasis on labour mobilization and reorganization of production and management with the reduction of industrial inputs in low-input and organic farming systems (Flora 1995, Hassanein and Kloppenburg 1995, Roberts and Hollander 1997). It also suggests that organic farming is associated with social/organizational innovation and complexity. This, in addition to greater diversification in production (see sections 4.7 – 4.10), suggests that organic farms have the potential to support more operators and households per acre farmed.
Table 4.5 Distribution of Organizational Forms of Zero Tillage and Organic Farms

<table>
<thead>
<tr>
<th></th>
<th>Zero Tillage</th>
<th></th>
<th>Organic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Single</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- husband</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>- husband/wife</td>
<td>10</td>
<td>30</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>- husband/wife/children</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>- husband/children</td>
<td>14</td>
<td>42</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>Partnerships:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- multifamily (unrelated)</td>
<td>1</td>
<td>39</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>- multifamily (related)</td>
<td>3</td>
<td>12</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>- multigenerational (related)</td>
<td>1</td>
<td>12</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In 1996, 72 percent of the farming operations in Saskatchewan reported one operator, and 28 percent reported two or more operators (Statistics Canada 1997). The largest number of farms in this study reported two operators, generally the husband and wife or the husband and a son. A significantly higher proportion of the organic farms had one operator, and only one of these was female.

Table 4.6 Number and Percent Distribution of Zero tillage and Organic Farms by the Number of Farm Operators Reported

<table>
<thead>
<tr>
<th>Number of Farm Operators</th>
<th>Zero Tillage Farms</th>
<th></th>
<th>Organic Farms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>4(1†)</td>
<td>12</td>
<td>10 (5†)</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>23(1†)</td>
<td>70</td>
<td>15 (3†)</td>
<td>46</td>
</tr>
<tr>
<td>3-4</td>
<td>5</td>
<td>15</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>100</td>
<td>33</td>
<td>100</td>
</tr>
</tbody>
</table>

† additional assistance on occasion from spouse or children

4.4.2 Farm Size

Several studies have reported that farm size and income have a positive correlation with the adoption of minimum and zero tillage (e.g., Benjaminson et al. 1994, Buttel et al. 1990, Heffernan and
Green 1986, Pampel and van Es 1977). Buttel et al. (1990) suggest that these correlations may be explained by both the high capital costs associated with zero tillage (due to a new inventory of specialized equipment and increased use of agrochemicals) and the potential to farm larger amounts of land. The time and labour savings that occur in a reduced tillage system may allow a farmer to reinvest this time and labour into increased farm size.

The relationship between farm size, income and the adoption of organic farming has been less consistent. Some studies have characterized organic farming operations as smaller and with lower income than conventional farms (e.g., Bird et al. 1995, Rusmore 1989). Jamtgaard (1991) and Stonehouse et al. (1993) found no significant differences in the size or income of conventional and organic farms. In a survey of 99 organic farms in Saskatchewan, Rutherford et al. (1992) reported that incomes of the organic farms were higher than conventional farms in the area when premium prices were received for organic commodities. The incomes of the two systems were similar without the premium prices. The differences in the findings of these and other studies may be due to greater diversity in production and size of organic farming systems. In many regions of the world organic production is predominantly associated with small-scale farming systems. In Saskatchewan, most of the organic farms are large-scale, diversified grain and livestock operations, but there are also some smaller operations concentrating on production of horticultural crops, herbs and other specialty crops. The market value of different organic commodities varies considerably. A small organic farm growing high value specialty crops, with additional diversification into processing and marketing, could generate as high or a higher gross income than a large-scale organic grain operation. Organic farming can, therefore, be a viable option for a wide range of production systems and farm sizes. Zero tillage, on the other hand, is ideally suited to capital-intensive, large-scale cropping operations.

Farm size in this study varied significantly (Figure 4.3). The smallest and the largest farms were organic operations. The smallest was a five acre organic herb production and processing operation run by a single female operator in the Black SCZ. The largest was a 7,840 acre organic grain and cattle farm operated by three related families of two generations in the Brown SCZ. The size of the zero tillage farms ranged from a 320 acre grain farm operated by a father and son in the Brown SCZ to a 7000 acre grain
farm operated by two brothers in the Dry Brown SCZ. The highest proportion of the organic farmers had 1280 acres of land or less. On the other hand, the majority of zero tillage farms (82 percent) were larger than 1280 acres while just under twenty percent were 1280 acres or less. The highest proportion of the zero tillage farms were 1281 to 2560 acres. The average size of the zero tillage farms was 2662 acres and the median value was 2500 acres. The average size of organic farms was 1761 acres and the median size was 1280 acres. The average size of zero tillage and organic farms in different soil climatic zones is shown in Table 4.7. These differences in the average sizes of zero tillage and organic farms have significant implications for farm structure and the structure of rural communities, and will be discussed in Chapter Six.

![Diversity of farms](image)

**Figure 4.3 Distribution of Farm Size for Zero Tillage and Organic Farms**

**Table 4.7 Average Size of Zero Tillage and Organic Farms by Soil Climatic Zone**

<table>
<thead>
<tr>
<th>Soil Climatic Zone</th>
<th>Average Size (acres)</th>
<th>Zero Tillage</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry Brown</td>
<td>2840</td>
<td>1800</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>3592</td>
<td>3857</td>
<td></td>
</tr>
<tr>
<td>Dark Brown</td>
<td>3244</td>
<td>2280</td>
<td></td>
</tr>
<tr>
<td>Moist Dark Brown</td>
<td>3433</td>
<td>1251</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>2357</td>
<td>953</td>
<td></td>
</tr>
<tr>
<td>Moist Black</td>
<td>2185</td>
<td>1393</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>2140</td>
<td>895</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>2662</td>
<td>1761</td>
<td></td>
</tr>
</tbody>
</table>

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A relationship is evident between farm size and soil climatic zone for both zero tillage and organic farming. Larger farms were located in the Brown SCZs, where low moisture conditions limit crop yields. Larger average farm size in these regions is due to the increased scale of cropping operations and the incorporation of rangeland on many farms, as ranching and mixed crop and livestock operations are more common in drier zones. With the exception of the Brown SCZ, zero tillage farms were significantly larger on average than the organic farms.

4.4.3 Land Tenure

The ownership of land is often cited as a significant factor motivating farmers’ maintenance of the productive potential of the resource base, whereas lack of ownership (e.g., renting or leasing land) is linked to resource degradation ( Lockeretz 1990). In Saskatchewan, concern has been expressed about the deterioration of soil quality as the amount of rented farmland steadily increases (Belcher 1999, Van Kooten and Furtan 1987). From 1971 to 1996, the share of rented farmland increased from thirty to forty percent of the total acreage farmed. The relationship between farming practices and land tenure has, however, been inconsistent and difficult to identify (Buttel et al. 1990). In a study of southern Saskatchewan farmers’ perceptions of property rights and responsibilities to the environment, Kristjanson (1997) suggests that security of tenure is a more appropriate variable to measure with regard to the use of sustainable practices.

Figure 4.4 presents data on land tenure. Organic farmers owned most of the land they farmed, whereas zero tillage farmers rented a significantly higher share of the land they farmed. Nearly three quarters of the organic farmers and less than half of the zero tillage farmers owned 75 percent or more of the land they farmed.
Other studies have also found organic farmers to have a high degree of ownership in the land they farm (e.g., Clancy et al., 1993, Lockeretz and Madden 1987). This suggests that farmers are more likely to make a transition to organic production on land that they own. Yields may decline during the transition period and certification requires that farmers' develop extended and diversified rotations. Organic farming therefore requires a long-term commitment. Most leasing agreements tend to favour arrangements that are low-risk and provide short-term financial gain. Organic production is therefore not as mobile as conventional methods of production. Farmers practising zero tillage are in a better position to rent. Yields under zero tillage management generally do not differ significantly from conventional management. The use of fertilizers and pesticides, to boost soil fertility and provide pest management, and the elimination of pre-seeding tillage operations also make it possible for zero tillage farmers to circumvent the need for long-term planning of crop rotations, and to make last-minute decisions about crop selection based upon market trends.
4.4.4 Off-farm Employment

More and more farmers in Canada are relying on off-farm employment to supplement income derived from farming. The percentage of Saskatchewan farmers reporting off-farm work increased from 35 percent in 1991 to 44 percent in 1996 (Statistics Canada 1997). In this study, farm operators were asked to report the number and gender of family members or farm operators engaged in either full-time or part-time off-farm employment. Sixteen (48 percent) of the zero tillage farms and 15 (46 percent) of the organic farms reported that farm income was being supplemented with off-farm work (Table 4.8).

Table 4.8 Off-Farm Employment on Zero Tillage and Organic Farms

<table>
<thead>
<tr>
<th>Number of Farms</th>
<th>Zero Tillage</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>16</td>
</tr>
</tbody>
</table>

Significant differences were identified between these two alternative farming systems with regard to the number of men and women working off-farm. More men from zero tillage farms and more women from organic farms had off-farm employment. A variety of jobs were reported for women from both types of farming operations, including nursing, teaching accounting, upholstering, janitorial work, and driving school bus. Off-farm employment for men included carpentry, welding, jobs in the oil and gas industry, teaching, practising law, and driving school bus.

In comparison to conventional farming methods, zero tillage is associated with decreased labour time requirements and higher capital costs. Conversely, organic farming is generally associated with increased labour and management requirements and lower capital costs than conventional farming systems. These general characteristics of these two alternative farming systems may explain why there were more men from zero tillage farms and more women from organic farms engaged in off-farm employment. Men tend to occupy the primary labour and management roles in commodity production on farms in Saskatchewan (see Section 5.5). Some of the men interviewed in this study reported that zero
tillage systems required less labour, which enabled them to earn extra income through off-farm work (Section 5.1.1.5). On the other hand, the increases in labour and reductions in capital costs generally associated with organic farming may limit the possibilities and/or reduce the need for men to work off the farm. When extra income is needed on organic farms, women are more likely to work off-farm.

4.4.5 Hired Labour

In 1996, 46 percent of farms in Saskatchewan reported hiring non-family hired labour (Statistics Canada 1997). The proportion of zero tillage farms using hired labour (19 or 58 percent) exceeded both the provincial average and the proportion of organic farms hiring off-farm help (10 or 30 percent). Forty-two percent of the zero tillage farms hired help for the farming operation only, 12 percent hired additional labour for other on-farm economic activities, and 4 percent hired help for both farming and other business operations. Twelve percent of the organic farms hired help for farming only, nine percent hired for other farm-based businesses, and nine percent hired assistance for both the farm and business operations.

The higher proportion of zero tillage farms hiring additional labour may be linked to the overall larger sizes of these operations. On some of the zero tillage farms, companies specialized in custom farm work were hired to supply both labour and equipment needs during spraying and harvesting. The organic farms were smaller, on average, and more diversified in crop and livestock production. This would tend to more evenly spread labour demands throughout the year. The organic farmers tended to rely more upon family members rather than to hire external farm labour. There also appeared to be greater use of reciprocal labour exchange, with extended family members and neighbours, on the organic farms examined.

4.4.6 Type of Production

Diversity in both crop and livestock production was significantly higher on the organic farms in this study. Over sixty percent of the organic farms combined crop and livestock production (Table 4.9).
These farms were distributed throughout each of the SCZs, and the highest numbers were in the Brown and Moist Black SCZs.

Table 4.9 Number and Percent Distribution of Zero Tillage and Organic Farms in Different SCZs with Mixed Crop and Livestock Production

<table>
<thead>
<tr>
<th>Soil Climatic Zone</th>
<th>Zero Tillage</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Dry Brown</td>
<td>1</td>
<td>25†</td>
</tr>
<tr>
<td>Dark Brown</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Moist Dark Brown</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Black</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Moist Black</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>Grey</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>24‡</td>
</tr>
</tbody>
</table>

† percentage of zero tillage or organic farms in that SCZ
‡ percentage of total zero tillage farms (33) or organic farms (33)

In contrast, most of the zero tillage farms (76 percent) examined were specialized in crop production. Only one quarter combined crop and livestock production. Livestock production on zero tillage farms was not evenly distributed throughout the SCZs. The highest number of zero tillage farms with livestock were in the Black SCZ and there was no livestock on farms in the Dark Brown and Moist Dark Brown SCZs. As will be discussed in Chapter Six, diversity in production has important implications for stability of farm income and also economic diversification opportunities and employment in a particular region. This, in turn, impacts on community structure and viability.

4.4.7 Livestock Profile

The number and types of livestock on the farms in this study are shown in Table 4.10. Cattle, pigs and poultry were produced on both organic and zero tillage farms. Buffalo, goat, sheep and miniatures were also raised on organic farms. One of the organic farms was certified for organic beef production. Other farmers were raising their livestock organically but had not become certified because of
the lack of organic processing and marketing outlets in the province. Overall, livestock production was more extensive and more diversified on organic farms.

Table 4.10 Types and Number of Livestock on Zero Tillage and Organic Farms

<table>
<thead>
<tr>
<th>Livestock</th>
<th>0-49</th>
<th>50-100</th>
<th>&gt;100</th>
<th>N(farms)</th>
<th>%±</th>
<th>0-49</th>
<th>50-100</th>
<th>&gt;100</th>
<th>N(farms)</th>
<th>%±</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>15</td>
<td>5</td>
<td>2</td>
<td>7</td>
<td>14</td>
<td>42</td>
</tr>
<tr>
<td>Pigs</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
<td>6</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Poultry</td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep</td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffalo</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horses</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Exotics</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

† number of farms with livestock  
‡ percentage of total number of zero tillage (3) or organic (33) farms

4.4.8 Crop Profile

The distribution of zero tillage and organic farms producing selected crops in rotation is shown below (Table 4.11). On the zero tillage farms, wheat, barley, and durum were the major cereal crops, peas and lentils were the major legume crops and canola and flax were the main oilseed crops grown in rotation. Wheat was the predominant crop followed by peas, barley and canola. Wheat was also the primary crop grown on organic farms. Other cereals grown organically included barley, oats and rye. Peas and lentils were also major legume crops on organic farms and flax was the main oilseed crop. Overall, there was a greater variety of cereals, legumes, as well as herbs and other speciality crops grown on organic farms. Zero tillage farmers grew a greater variety of oil seed crops.
Table 4.11 Number and Percent Distribution of Zero Tillage and Organic Farms Producing Selected Crops in Rotation

<table>
<thead>
<tr>
<th>Crop</th>
<th>Zero Tillage Farms</th>
<th></th>
<th>Organic Farms</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td>Grain: Wheat†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>21</td>
<td>64</td>
<td>16</td>
<td>48</td>
</tr>
<tr>
<td>Durum</td>
<td>14</td>
<td>42</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>Oats</td>
<td>7</td>
<td>21</td>
<td>16</td>
<td>48</td>
</tr>
<tr>
<td>Winter Wheat</td>
<td>5</td>
<td>15</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Rye</td>
<td>1</td>
<td>3</td>
<td>16</td>
<td>48</td>
</tr>
<tr>
<td>Triticale</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Quinoa</td>
<td>8</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buckwheat</td>
<td>7</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kamut</td>
<td>7</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Millet</td>
<td>6</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spelt</td>
<td>3</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emmur</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legume: Pea</td>
<td>24</td>
<td>73</td>
<td>16</td>
<td>48</td>
</tr>
<tr>
<td>Lentil</td>
<td>13</td>
<td>39</td>
<td>16</td>
<td>48</td>
</tr>
<tr>
<td>Chickpea</td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bean</td>
<td></td>
<td></td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>3</td>
<td>9</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Clover</td>
<td>1</td>
<td>3</td>
<td>14</td>
<td>42</td>
</tr>
<tr>
<td>Black medoc</td>
<td></td>
<td></td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Oilseed: Canola</td>
<td>21</td>
<td>64</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Flax</td>
<td>16</td>
<td>48</td>
<td>16</td>
<td>48</td>
</tr>
<tr>
<td>Sunola</td>
<td>3</td>
<td>9</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Linola</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safflower</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunflower</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Mustard</td>
<td>5</td>
<td>15</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Other:</td>
<td>3</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canary seed</td>
<td></td>
<td></td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Fenugreek</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Grass</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Radish</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Coriander</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Cress</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Borage</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Caraway</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other herbs</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

† all spring seeded wheat varieties

4.4.9 Crop Diversity and Crop Rotation

Many of the zero tillage and organic farmers interviewed considered crop diversity and length of crop rotation to be important to weed, disease, crop residue and soil fertility management. Although crop
diversity was fairly high on most of the farms in this study, in comparison to the conventional wheat/fallow rotation there was a greater diversity of crops grown on organic farms (Table 4.12). Forty-five percent of the organic farmers grew 7 crops or more. Only 27 percent of the zero tillage farmers grew seven crops or more in rotation. The data gathered here reveals a trend to an increasing diversity of crops grown in rotation with increased moisture availability in SCZs (as in the order shown). This trend was most evident for the organic systems.

Table 4.12 Distribution of Zero Tillage and Organic Farms in Different SCZ by the Number of Crops Grown in Rotation

<table>
<thead>
<tr>
<th>N(crops)</th>
<th>DrB</th>
<th>Br</th>
<th>DB</th>
<th>MDB</th>
<th>B</th>
<th>MB</th>
<th>G</th>
<th>Total</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zero Tillage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>4-6</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>2</td>
<td></td>
<td>20</td>
<td>61</td>
</tr>
<tr>
<td>7-9</td>
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<tr>
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<td>6</td>
<td>3</td>
<td></td>
<td>33</td>
<td>100</td>
</tr>
</tbody>
</table>

DrB = Dry Brown, Br = Brown, DB = Dark Brown, MDB = Moist Dark Brown, B = Black, MB = Moist Black, G = Grey

The distribution of zero tillage and organic farms practising continuous cropping or summerfallowing by length of rotation is shown in Tables 4.13 and 4.14. It should be noted that rotations differed considerably from farm to farm, and most of the farmers commented that their rotations were not “written in stone,” but were subject to modification depending on moisture conditions, markets, and their success in growing different crops. Nearly 80 percent of the zero tillage farmers practiced continuous cropping and the remainder continued to use summerfallowing on part of their farmland. The highest

130
proportion of the zero tillage farmers that cropped continuously used a four year crop rotation, whereas most of those that summerfallowed followed a three year crop rotation. The length of crop rotations tended to increase with increasing moisture availability in the different SCZ (in the order presented). Most of the zero tillage farms utilizing summerfallowing were situated in the driest SCZs (Dry Brown and Brown).

Table 4.13 Distribution of Zero Tillage Farms (in different SCZ) Practicing Continuous Cropping or Summerfallowing by Length of Rotation

<table>
<thead>
<tr>
<th>Rotation (years)</th>
<th>DrB</th>
<th>Br</th>
<th>DB</th>
<th>MDB</th>
<th>B</th>
<th>MB</th>
<th>G</th>
<th>Total</th>
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<tbody>
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<tr>
<td>Continuous Cropping</td>
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<tr>
<td>2</td>
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<td>1</td>
<td>1</td>
<td>1†</td>
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<tr>
<td>3</td>
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<td>2,1†</td>
<td>3,1†</td>
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<td>1†</td>
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<tr>
<td>&gt;5</td>
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<td>Summerfallowing</td>
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<tr>
<td>2</td>
<td>4</td>
<td>1†</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1†</td>
<td>5</td>
<td>15</td>
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<td>3</td>
<td>4</td>
<td>1†</td>
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<td>1†</td>
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<td>&gt;5</td>
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</tbody>
</table>

† 5% or less summerfallowing; ‡ 5% or less continuous cropping

Fewer organic farmers practiced continuous cropping (33 percent) and more relied upon summerfallowing (67 percent). Most of those practicing summerfallowing were in the Brown SCZs. The highest proportion of those practicing summerfallowing had a three-year crop rotation, but there were also a significant number with rotations four years or longer. Most of those that continuous cropped had four year rotations. The highest number of organic farms continuous cropping were located in the Moist Black SCZ and the remainder were located in the Brown, Moist Dark Brown and Grey SCZ. Most of the organic farmers that continuous cropped ended their rotation with a legume green manure crop which is
cut and worked under in late June or early July. Some organic farmers leave strips of these green manure crops standing as snow traps in order to increase moisture levels for the following crop year.

Table 4.14 Distribution of Organic Farms (in different SCZ) Practicing Continuous Cropping or Summerfalling by Length of Rotation

<table>
<thead>
<tr>
<th>Rotation (years)</th>
<th>DrB</th>
<th>Br</th>
<th>DB</th>
<th>MDB</th>
<th>B</th>
<th>MB</th>
<th>G</th>
<th>Total</th>
<th>N</th>
<th>%</th>
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<td>Summerfalling</td>
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<td>1</td>
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<td>6</td>
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</tr>
<tr>
<td>&gt;5</td>
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<td>3</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>

† rotation ends with either an alfalfa or clover crop which is cut and turned under
‡ 5% or less continuous cropping

The findings reported here are consistent with the trends in cropping practices emerging in Saskatchewan. Due to economic, environmental and agronomic factors, an increasing number of farmers in Saskatchewan are moving towards more continuous cropping with more extended and diversified rotations and decreased summerfalling and tillage. Continuous cropping increases the productivity of the land and generally decreases the erosion potential, but has also been associated with increased use of fertilizers and pesticides. Summerfalling continues to be used mainly by farmers in the drier regions of the province, primarily due to economic and agronomic factors. Although summerfalling has been linked to soil erodibility, erosion can be managed on land that is summerfallowed by reducing the number of tillage operations and by maintaining adequate crop residue (Campbell et al. 1990).
Since organic farmers choose not to use most fertilizers and herbicides, they might be expected to have more difficulty in managing continuous cropping and therefore to continue to rely upon tillage and summerfallowing. Many organic farmers are aware of the negative impact of excessive summerfallowing and tillage and have moved to conservation tillage methods and more extended and diversified rotations (Bird et al. 1995, Clancy et al. 1993, Matheson 1989, Rutherford 1992). Some organic farmers have developed continuous cropping systems by using legume green manure crops to end rotations. Farmers who practice minimum or zero tillage have either eliminated or are in a process of eliminating tillage and summerfallowing. Although many zero tillage farmers are moving to more diversified and extended rotations, there is still reliance upon fertilizers and pesticides to maintain soil fertility and control weeds and other pests.

4.4.10 Methods of Weed Control

Changes in weed populations have been identified with the transition to organic and zero tillage practices (e.g., Leeson 1998, Tomas 1997). Weeds commonly reported for organic systems in Saskatchewan include wild mustard (*Brassica kaber* (DC.), green foxtail (*Setaria viridis* (L.)), wild oats (*Avena fatua* (L.)), lamb's quarters (*Chenopodium album* (L.)), and quack grass (*Agropyron repens* (L.)). The weeds most prominent in zero tillage systems within the Province are dandelions (*Taraxacum ceratophorum* (Ledeb.) DC.), Canada thistle (*Cirsium arvense* (L.) Scop.), perennial sow thistle (*Sonchus arvensis* (L.), and quack grass (*Agropyron repens* (L.)). Weed control methods reported by organic and zero tillage farmers are presented in Table 4.15.
Table 4.15 Number and Percent Distribution of Zero Tillage and Organic Farms using Various Weed Control Methods

<table>
<thead>
<tr>
<th>Zero Tillage</th>
<th>Methods of Weed Control</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-crop spraying</td>
<td></td>
<td>28</td>
<td>85</td>
</tr>
<tr>
<td>Spring burn-off with Roundup</td>
<td></td>
<td>27</td>
<td>82</td>
</tr>
<tr>
<td>Fall treatment with Roundup</td>
<td></td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Summerfallowing</td>
<td></td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Fall 2,4-D</td>
<td></td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Fall herbicide incorporation</td>
<td></td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Chemical fallow</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Tillage</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organic</th>
<th>Tillage</th>
<th>33</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summerfallow</td>
<td></td>
<td>22</td>
<td>67</td>
</tr>
<tr>
<td>Spring cultivation/seed later and heavier</td>
<td></td>
<td>17</td>
<td>52</td>
</tr>
<tr>
<td>Post-emergent harrowing</td>
<td></td>
<td>17</td>
<td>52</td>
</tr>
<tr>
<td>Diversified, extended rotation</td>
<td></td>
<td>16</td>
<td>49</td>
</tr>
<tr>
<td>Green manure</td>
<td></td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Under-seed with clover</td>
<td></td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Alleoplastic crops</td>
<td></td>
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<td>21</td>
</tr>
<tr>
<td>Rotary harrow</td>
<td></td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Rotary hoe</td>
<td></td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Competitive crops</td>
<td></td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Intercropping</td>
<td></td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Row cropping</td>
<td></td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Hand rogueing</td>
<td></td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Seed early</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Rod weeder</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Deep tillage for perennial weeds</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Spot mow</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Lunar schedule for planting and cultivation</td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
A number of cultural and biological weed control methods were used by the organic operators. The most common methods include tillage, summerfallowing, delayed seeding with a heavier seeding rate\(^7\), post-emergent tillage of the crop seedlings\(^8\), diversified and extended rotations, green manure, under seeding crops with clover and the use of allelopathic crops\(^9\). Zero tillage farmers, on the other hand, relied upon a more limited number of approaches to weed control, mainly involving the use of pesticides. The predominant methods identified included spring burn-off with Roundup, in-crop spraying of selected herbicides for specific weed problems, and fall treatment with Roundup.

Many zero tillage farmers commented that the use of Roundup was critical to their cropping systems and most were not concerned about the increased use of this broad-spectrum herbicide as they felt it was extremely safe to use. There were, however, some zero tillage farmers who expressed concern about increased use of pesticides in zero tillage systems. Some zero tillage farmers commented on the importance of using chemical rotation to help delay the development of herbicide resistance. One farmer said that farming had become more complex with increased reliance upon chemicals. He added that he had to spend a considerable amount of time in the winter becoming educated about the various herbicides available in order to develop a chemical rotation suitable for this cropping system.

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7. By seeding later (from mid- to the end of May, as opposed to the end of April to mid-May) there is time to kill young weeds with a pre-seeding tillage operation. To compensate for crop damage due to post-emergent tillage operations, a heavier seeding rate is often used.
8. Tine harrows, rotary harrows, and rotary hoes were reported for use in post-emergent tillage operations.
9. Rutherford et al. (1992) characterize allelopathic crops as those releasing natural herbicides which can be used to control weeds in crop rotations. For example, a canola crop will reduce Kochia, green foxtail, and wild oats (Coxworth et al. 1990). Farmers also reported other crops, such as winter wheat, fall rye, oats, buckwheat, and sweet clover as having allelopathic properties.
4.4.11 Additional On-farm Economic Diversification

Additional on-farm economic diversification was reported by 9 (27 percent) of the zero tillage farms and 8 (24 percent) of the organic farms. There was a wide range of economic activities reported, including an agrochemical dealership, registered seed cleaning and bagging, cleaning and processing plants, bed and breakfasts, preparation and marketing of sprouting mixes, carpentry, organic commodity brokering, pottery, concrete and trucking, and farm equipment design and manufacturing. The case can be made that organic production is in itself a form of on-farm diversification due to the relatively high number of crop and livestock “enterprises” associated with these farming systems (Sections 4.7-4.10).

4.4.12 Machinery and Other Purchased Inputs

Farmers in this study were asked what effect the transition to an alternative farming practice had on their use of purchased inputs. The response of the zero tillage farmers is presented below (Table 4.16).

Table 4.16 Use of Agrochemicals, Fuel, and Machinery with the Transition to Zero Tillage

<table>
<thead>
<tr>
<th>Capital Inputs</th>
<th>Increase</th>
<th></th>
<th>Decrease</th>
<th></th>
<th>No Change</th>
<th></th>
<th>No Response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>Pesticides</td>
<td>16 (5†)</td>
<td>49</td>
<td>6</td>
<td>18</td>
<td>3</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>15</td>
<td>46</td>
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<tr>
<td>Fuel</td>
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<td>21</td>
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<tr>
<td>Equipment</td>
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<td>15</td>
<td>18</td>
<td>55</td>
<td></td>
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<td>10</td>
</tr>
</tbody>
</table>

† specific reference to noted increases in the use of Roundup

Nearly one-half of the zero tillage farmers reported increases in fertilizer and pesticide use. Fifty-five percent of the zero tillage farmers reported that they were able to reduce their machinery and equipment inventory by selling their conventional tillage and seeding equipment. Many of these farmers also commented that in making the transition to zero tillage they had made significant capital investments in an air seeder, spraying equipment and a bigger tractor. Just over a third of the zero tillage farmers reported decreased fuel consumption. For reasons unknown, a significant proportion of the farmers did not comment on the use of selected inputs.
All the organic farmers reported a significant decrease in capital inputs with the transition to organic farming, primarily due to the elimination of synthetically manufactured fertilizers and pesticides. None of the organic farmers reported a change in fuel use and only one farmer reported increased capital investment in machinery with the purchase of a rotary hoe. A small number of organic farmers reported using rock phosphate, gypsum, borax, registered nutrient solubilizing microbial seed inoculants (e.g., Provide (PB-50) and Enrich). In addition to these purchased inputs, a third of the organic farmers reported using livestock manure, and a majority of the farmers used legumes in rotation to increase nitrogen fertility. Rutherford and Gimby (1990) and Rutherford et al. (1992) found soil phosphorus levels were lower than needed for optimal crop growth on most of the Saskatchewan organic farms they studied. These authors identified this as a major problem facing organic farmers in Saskatchewan and suggested that a combination of rock phosphate and an inoculant of Penicillium fungus, such as Provide, be used to restore phosphorus levels in the soil.

4.5 Summary

The general characteristics of the zero tillage and organic farming systems examined in this study are summarized in Table 4.19.

The farming populations sampled in this study were fairly representative of the range of ages, education, and farming experience found in the general farm population, but some differences were identified. The average age of both zero tillage and organic farmers was slightly younger than the general farming population. The organic farmers had more post-secondary education and more experience with alternative farming practices than the zero tillage operators, who had more general farming experience. Zero tillage farmers were more involved in formal agricultural research, but participation in community and agricultural organizations was higher for organic farmers.

10. According to Parr et al. (1983), the materials used to maintain soil fertility in organic systems have low water solubility and require longer to enter the growing system than synthetic fertilizers. Because of this slow release or availability, organic fertilizers limit leaching and are a more stable source of nutrients than synthetic fertilizers. Dr. Bix Biederbeck, an Agriculture Canada research scientist, stated that legumes in rotation not only fix atmospheric nitrogen, they also increase phosphorus solubilization in the soil (personal
Table 4.17 General Characteristics of Zero Tillage and Organic Farming Systems

<table>
<thead>
<tr>
<th></th>
<th>Zero Tillage</th>
<th>Organic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size of Operations</strong></td>
<td>Large</td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>Mean = 2667 ac; Median = 2500 ac</td>
<td>Mean = 1761 ac; Median = 1280 ac</td>
</tr>
<tr>
<td><strong>Land Tenure</strong></td>
<td>Relatively high ownership, but with</td>
<td>Extremely high ownership</td>
</tr>
<tr>
<td></td>
<td>a significant amount rented</td>
<td></td>
</tr>
<tr>
<td>**Organization of the</td>
<td>Predominantly family owned and</td>
<td>Predominantly family owned and</td>
</tr>
<tr>
<td>Farming Enterprise**</td>
<td>operated</td>
<td>operated. Relatively high number of farms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in partnerships.</td>
</tr>
<tr>
<td><strong>Labour Source</strong></td>
<td>High reliance upon non-family hired</td>
<td>High reliance upon family and</td>
</tr>
<tr>
<td></td>
<td>labour</td>
<td>neighbours for labour exchange</td>
</tr>
<tr>
<td><strong>Type of Production System</strong></td>
<td>Specialized cropping systems</td>
<td>Diversified crop and livestock operations</td>
</tr>
<tr>
<td><strong>Crop Diversity and Length of</strong></td>
<td>Relatively moderate</td>
<td>Relatively high</td>
</tr>
<tr>
<td>Rotation**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Use of Summerfallowing and</td>
<td>Low (~ 1/5 of the farms)</td>
<td>High (~ 2/3 of the farms)</td>
</tr>
<tr>
<td>Tillage**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Methods of Weed Control</strong></td>
<td>The use of agrochemicals, particularly</td>
<td>A wide variety of biological and</td>
</tr>
<tr>
<td></td>
<td>Roundup</td>
<td>cultural methods</td>
</tr>
<tr>
<td>**Involvement with Formal</td>
<td>Relatively high</td>
<td></td>
</tr>
<tr>
<td>Agricultural Research**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Involvement in Community and</strong></td>
<td>Relatively moderate</td>
<td>Relatively high</td>
</tr>
<tr>
<td>Agricultural Organizations**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Off-Farm Employment</strong></td>
<td>~ 1/2 of the farms</td>
<td>~ 1/2 of the farms</td>
</tr>
<tr>
<td>**Additional On-Farm</td>
<td>~ 1/4 of the farms</td>
<td>~ 1/4 of the farms</td>
</tr>
<tr>
<td>Diversification**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Zero tillage farmers tend to have large specialized cropping operations and rent a significant proportion of the land they farm. Organic farmers tend to own most of the land they farm and to have smaller more diversified crop and livestock production systems. Although the majority of both zero tillage and organic farms were family owned and operated, a higher proportion of the organic farms were operated in partnership. There was a greater reliance by zero tillage farmers on non-family hired labour, whereas organic farmers depended more upon family members or reciprocal labour exchange with extended family or neighbours. Similar to the trend occurring throughout Canada's farming population, close to one-half of both organic and zero tillage farm households in this study relied upon off-farm employment to supplement farm income. More men from zero tillage farms and more women from

communication 1995).
organic farms worked off-farm. Approximately one-fourth of both zero tillage and organic farms had developed other businesses on-farm.

Most of the zero tillage farmers had eliminated summerfallowing and tillage, and were practising continuous cropping. Conversely, the majority of the organic producers continued to rely upon tillage and summerfallowing, but many had reduced the number and severity of the tillage operations and had developed extended and diversified rotations. Most of the organic farmers that continuous cropped incorporated a legume green manure crop to end rotations. Summerfallowing continued to be practised by both organic and zero tillage farmers situated in the drier regions of the province. Organic farmers utilized a diverse set of cultural and biological weed control methods, whereas zero tillage farmers mainly relied on the use pesticides, particularly Roundup, to control weeds.

There were significant changes reported in the use of purchased inputs by both zero tillage and organic operators. The highest proportion of zero tillage operators reported increases in the use of fertilizers and pesticides, but decreases in fuel use. Although machine inventory was reduced, specialized and larger scale equipment was purchased for zero tillage operations. Organic farmers, on the other hand, reported significant savings with the elimination of most fertilizers and all pesticides, but reported no changes in fuel use or machine or equipment inventory.
CHAPTER FIVE: THE FARM INTERVIEWS II: TRANSITIONS, GOALS, PERCEPTIONS AND PREDICTIONS

5.1 Introduction

The preceding chapter provided information about the characteristics of the farmers and the structural characteristics of the farming operations in this study. In this chapter I explore the ideologies that motivate and shape the actions and perceptions of these farmers. In Section 5.2, the transition to an alternative farming practice is examined through an analysis of the following: factors farmers identify as having influenced their transition, sources of information and support, commitment to an alternative farming practice, and future goals. Farmers’ perceptions of sustainable agriculture and their predictions about the future of farming in Saskatchewan are presented in Sections 5.3 and 5.4. Gender issues are discussed in Section 5.5.

5.2 The Transition to an Alternative Farming Practice

5.2.1 Factors Influencing the Decision

Zero tillage and organic farming practices are being adopted by farmers in Saskatchewan in response to problems associated with conventional agriculture. Farmers in this study were asked to identify and describe the factors or concerns that had influenced their adoption of an alternative farming practice. Their responses were grouped into five broad categories: environmental, health, economic, philosophical/spiritual and labour/time (Figure 5.1). The specific concerns or factors within each of these categories are shown in the following table (Table 5.1).
Figure 5.1 Factors Influencing the Transition to an Alternative Farming Practice

<table>
<thead>
<tr>
<th>Environment</th>
<th>Zero tillage Farmers</th>
<th>Organic Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>-soil erosion</td>
<td>-use of agrochemicals- impact on soils, water, wildlife, increasing pesticide resistance</td>
</tr>
<tr>
<td></td>
<td>-declining soil quality</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td>-use of agrochemicals- increased health risks for farmers, farm families and consumers</td>
</tr>
<tr>
<td>Economic</td>
<td>-input costs</td>
<td>-input costs</td>
</tr>
<tr>
<td></td>
<td>-yields</td>
<td>-commodity prices</td>
</tr>
<tr>
<td></td>
<td>-productive capacity of land base</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-diversity and flexibility in crop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>production</td>
<td></td>
</tr>
<tr>
<td>Philosophical/Spiritual</td>
<td></td>
<td>-increasing industrialization and consolidation in agriculture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-increasing dependence on external inputs and processes in farming systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-loss of community and stewardship</td>
</tr>
<tr>
<td>Labour/Time</td>
<td>-expand or diversify farm operation</td>
<td>-diversify farm operation</td>
</tr>
<tr>
<td></td>
<td>-off-farm work</td>
<td>-reorganization of labour and management</td>
</tr>
<tr>
<td></td>
<td>-family time</td>
<td>-family time</td>
</tr>
</tbody>
</table>
5.2.1.1 Environmental

The most common factor influencing the transition to an alternative farming practice was concern about the environmental effects associated with conventional agriculture. For the zero tillage farmers, soil erosion and the overall loss of soil quality due to conventional tillage and summerfallowing were the focus of these concerns.

One spring, as I was walking the fields, I saw the erosion and thought what a horrible legacy (ZT-1).¹

I liked the concept of not disturbing the land. Summerfallowing always bothered me, the loss of moisture and topsoil (ZT-2).

The soil was getting hard, baking up. I wanted to get it more mellow (ZT-3).

The organic farmers, on the other hand, were primarily concerned about the effects of agrochemical use on the environment (e.g., soil and water quality, wildlife habitat, genetic resistance to pesticides).

During the late 1970s and early 1980s I read how pesticides were killing birds and beneficial insects. I asked myself what they might be doing to humans. Then later I read about the increase in pesticide resistance. I have also traveled a lot in South America. I saw people having farmed for generations without chemicals. They care a lot about the soil. They use sophisticated rotations and other methods we haven’t even heard of. All these things convinced me to stop using chemicals altogether (O-1).

Considering the environmental risks, why would anyone want to use chemicals? It’s nice to see a clean crop, but not if you know its been sprayed and affecting the whole ecosystem (O-2).

Chemicals don’t do the environment any good. I wanted to improve the land through good rotations and not use chemicals. At first, I was concerned about increasing tillage and soil erosion in an organic system. But I think good rotations and the use of a clover ploughdown has actually decreased erosion and improved soil tilth (O-3).

5.2.1.2 Health

Thirty (91 percent) organic farmers, and none of the zero tillage farmers, reported that health concerns had also influenced their transition to an alternative farming practice. The use of agrochemicals,

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¹ In this chapter, the excerpts from the farm interviews are referenced by identifying the source as either a zero tillage (ZT) or organic (O) farmer, and are numbered according to the order in which they first appear in the text. Additional information about the source is provided in Appendix B regarding gender, age, education, years of experience with zero tillage or organic management, number of acres farmed, type of farming operation (crop, mixed crop and livestock).
particularly pesticides, was again the main focus of those concerns. Many said they felt the use of pesticides put them and their families at risk.

I was always the one to do the spraying for our farm operation. But it got to the point I simply didn’t want to spray anymore. I was always getting sick at spraying time. I felt I was too old to handle it anymore. But you know, I never met a farmer who said they liked spraying. A lot of them do it because of peer pressure (O-4).

I started wondering why I should use chemicals. When you have to wear rubber gloves and a mask, that tells you it can’t be good for anyone or anything. My main concern about chemicals was contamination of our groundwater. We have sand point wells here (O-5).

My father was a grain buyer and chemical dealer during the 1950s and 1960s. He stored the chemicals in his office. The smell really got to him. When he went back to farming he quit using chemicals. So this farm has been chemical free for a long time. But I’m always sick during spraying season. The chemicals are in the air from all the other farmers spraying (O-2).

Two of the organic farmers described how accidents with pesticides had caused them to change their approach to farming.

Many years ago I had a bad accident with a grasshopper pesticide. As I was checking the sprayer, one of the hoses broke and I got sprayed. I was terribly sick for a while. I still have problems. It made me re-evaluate my way of doing things (O-6).

I had an accident with a fungicide that threw me into intensive care for two days. After that I made a decision to quit using chemicals (O-7).

For other organic farmers, it was their concerns about the consumption of food grown with agrochemicals that had a significant impact on their farming decisions.

I feel much better farming organically. I couldn’t face anyone eating my products, knowing that they had chemicals on them that might put their health at risk. I’d rather quit farming if I had to farm with chemicals (O-1).

5.2.1.3 Economic

Twenty-four (73 percent) of the organic farmers and 20 (61 percent) of the zero tillage operators reported that economic factors had influenced their transition to an alternative farming practice. Reducing the cost of production was a major economic concern influencing some farmers to make the transition to organic agriculture. Premium prices for organic commodities were also a consideration for some farmers.

Economics was my primary reason for making the transition. I was practising minimum tillage and going broke. My sister’s a scientist and she started sending me information about organic
farming. I did a lot of reading. When I read over the results from the SRC study\(^2\), I became
convincing that going organic was a good option for me. I made the transition fast in order to get
into the organic markets and get the premium prices. It’s worked out well. I’ve had a hundred
percent turn around economically (O-8).

It’s cheaper for me to farm without chemicals. And besides, isn’t the environmental damage due
to the use of chemicals more costly to everyone in the long run (O-2)?

Some farmers turned to zero tillage as a way to decrease production costs or as a way to climb out of
debt.

I didn’t have a choice. I was going in the hole. I just took a chance on zero tillage. Now, we’re
finding the cost of machinery, time, and labour is down by 50 percent (ZT-4).

Our primary reason to go zero till was to find a way to farm cheaper and the drop in the price of
Roundup made it possible. Roundup has changed our lives (ZT-5).

Increased yields, improved conditions for continuous cropping and the potential to grow a wider range of
crops were the main economic attractions of zero tillage for other farmers.

We were told that production would increase over time, with less work. Even though it wasn’t
cheap to make the transition, we thought it would involve less risk over time (ZT-6).

Our primary goal was to continuous crop high quality product and zero tillage promised that
(ZT-1).

5.2.1.4 Philosophical and Spiritual

Fifteen (46 percent) of the organic farmers identified philosophical and spiritual reasons for
adopting an organic approach, but none of the zero tillage operators identified these factors as significant
to their adoption. Most of these organic farmers were attracted to organic agriculture for ideological
reasons. For some farmers, the organic approach was seen as a way to farm with greater independence
and self-sufficiency, by decreasing the need for purchased inputs and working more with on-farm
resources. For other farmers, organic agriculture was identified as a form of resistance to the increasing
capitalization and corporatization of the conventional agricultural system.

I wanted to be part of a movement to take control back, to break free of corporate control over
agriculture, through local growing, processing and consumption of food. I’ve always questioned
things. To challenge the status quo you have to be a strong individual, confident and
experimental (O-9).

I guess I’m an old hippie. I began farming with a philosophy of getting back to the land and
living more self-sufficiently. Organic fit with that ideology. I also wanted be to a good farmer.

so the first five to six years I vacillated between being a good conventional farmer, like my dad, and responding to my ideology. I got turned off initially by the fanaticism of some of the organic farmers. I wanted more mainstream scientific information about it, but there wasn’t much. But over the years, I’ve realized the substance in the anecdotal information from those farmers. I guess what really pushed us to make the transition was that we began buying organic flour from a neighbour. I started thinking, if we don’t want to eat chemically grown wheat, why should we be growing it (O-10)?

Four farmers (12 percent) spoke of religious and spiritual beliefs guiding their decisions to farm organically.

My primary reason in becoming organic was my Christian beliefs. The land is to be used for good, to live and enjoy it and to make use of it with an attitude of stewardship…not to exploit (O-11).

5.2.1.5 Labour/Time

Labour and time were identified as significant factors influencing the transition to an alternative practice by 12 (36 percent) of the zero tillage farmers and 4 (12 percent) of the organic farmers.

For some of the zero tillage farmers, savings in time and labour facilitated increased farm size, while for others it made it possible for them to farm alone, work off the farm or have more time with their family.

I have a relatively large land base and I didn’t want to hire help. I’d rather have machinery to deal with than troubles with hired help. So I decided to go to a minimum and zero tillage system. I invested in bigger new equipment so I could continue to farm by myself (ZT-3).

Some organic farmers commented that they not only saved time in going organic but they were also able to more evenly spread the workload. Some reinvested this time and labour in on-farm processing and marketing and others used it to increase the time spent with family. Other organic farmers commented that saving labour or time was not an issue for them.

We get a lot of satisfaction from doing things ourselves--baking bread, sewing, gardening, making preserves, building an energy efficient house, doing most of our own mechanics. So putting time and labour into farming the way we want isn’t a problem for us (O-12).

5.2.2 Sources of Information and Support

Access to relevant information, through formal and informal channels, has been shown to play an important role in adoption of agricultural innovations (Rogers 1983). Farmers in this study were asked to identify sources of information and support that were useful to them in making the transition to zero
tillage and organic farming. Although there was considerable overlap in the sources identified, the relative importance of these sources differed significantly for these two groups of farmers (Table 5.2). For example, 58 percent of the zero tillage farmers, but only 18 percent of the organic farmers identified Agriculture Canada as an important source. Other farmers were identified as sources of information and support by 76 percent of the organic farmers and by 45 percent of the zero tillage farmers. Personal observation and experimentation was an important source of information for 36 percent of the organic farmers and for 12 percent of the zero tillage farmers. There were also some sources referenced exclusively by zero tillage or organic farmers. The SSCA, Mandak, agrochemical and equipment companies and dealers were some of the more common sources identified by zero tillage farmers. Sources identified by organic farmers only included OCIA, the alternative agriculture press, SODC, the Girvin Co-operative, and Earthcare.

Overall, zero tillage farmers expressed satisfaction with their main sources of information and support, including soil conservation organizations (SSCA, Mandak and local conservation clubs), provincial and federal research and extension agencies, and agribusiness firms.

There’s been good support top-down. The institutions are doing very positive work. There’s blunders here and there, but overall, there’s very good intentions and support (ZT-5).

A few zero tillage farmers, however, felt support from public agencies was inadequate or slow to emerge.

Until recently, only certain individuals in the institutions were interested. There’s been a lot of negativism from the College of Agriculture. There’s been very little funding for the agronomic development of zero tillage (ZT-7).

Zero tillage was initiated and largely driven by farmers. Government and researchers are playing catch up now (ZT-8).

Many of the organic farmers commented that there was little government and institutional support for organic agriculture and that they would like to see increased support, particularly in research and extension. Some expressed their views as to why they thought support was lacking.

Organic agriculture is certainly not a priority for government. There have been certain individuals that have been very supportive, with a personal interest in seeing alternatives given a chance. Now we’re getting a bit more attention because of the niche market potential. Overall, there’s been a small amount of support, not enough (O-13).
The department of agriculture humours us. Some of those in research, who have had contact with organic farmers and have seen their systems, can see the good in it. Those that stay in their offices still don’t believe it’s worth anything. If we could even get a small percent of the support that zero till gets (0-4).

### TABLE 5.2 SOURCES OF INFORMATION FOR ZERO TILLAGE AND ORGANIC FARMERS

<table>
<thead>
<tr>
<th>Sources of Information</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSCA</td>
<td>27</td>
<td>82</td>
</tr>
<tr>
<td>Agriculture Canada</td>
<td>19</td>
<td>58</td>
</tr>
<tr>
<td>Provincial extension agrologists</td>
<td>17</td>
<td>52</td>
</tr>
<tr>
<td>Other farmers</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Conventional agriculture press</td>
<td>14</td>
<td>42</td>
</tr>
<tr>
<td>Mandak</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Agrochemical co. and dealers</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Conferences</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Equipment co. and dealers</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>College of Agriculture</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Field days/workshops/seminars</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Newsletters</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Books</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Personal observation/expt.</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>PFRA</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>ADD</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Local marketing club</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Local conservation club</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Ducks Unlimited</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Pulse Growers Assoc.</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Canola Council</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Scientific Journals</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Alternative agriculture press</td>
<td>27</td>
<td>82</td>
</tr>
<tr>
<td>Other farmers</td>
<td>25</td>
<td>76</td>
</tr>
<tr>
<td>OCIA</td>
<td>20</td>
<td>61</td>
</tr>
<tr>
<td>Books</td>
<td>17</td>
<td>52</td>
</tr>
<tr>
<td>Conventional agriculture press</td>
<td>14</td>
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<tr>
<td>Personal observation/expt.</td>
<td>12</td>
<td>36</td>
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<tr>
<td>Provincial extension agrologist</td>
<td>10</td>
<td>30</td>
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<tr>
<td>College of Agriculture</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Conferences/meetings</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Agriculture Canada</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>SODC</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>Girvin Coop</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Field days</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>Earthcare</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>CROP</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>EAP</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>AERO</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>IFOAM</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>The internet</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Carrington Research Station</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>SRC</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Local conservation club</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

**Zero Tillage farmers**

**Organic Farmers**

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One organic farmer felt that lack of support from formal agricultural agencies was not necessarily a bad thing.

Organic agriculture in Saskatchewan has been developed by some very dedicated individuals working more or less in isolation from other areas where organic was more accepted. I like it that we (the farmers) have been and are still in control of the development here. It may be moving more slowly because of it, but we're still in control (O-14).

Most of the organic farmers had positive things to say about the organic organizations they belonged to, such as OCIA, CROP and SODC. A few commented that OCIA was too top-down, too political and did not provide enough good agronomic advice. One farmer explained why he thought local organic organizations were not as effective as they might be.

Organic farmers in Saskatchewan are a small and highly divided group on a number of different issues. It's been difficult to organize and create an effective provincial organization that could provide support and information (O-15).

Another farmer commented on the importance of international support and information networks that have been developing for organic farmers.

There's much more international networking going on for organic farmers now. We need that global outlook and network for lending support. We need to learn from each other and create a community. Organic agriculture is meant to create community (O-9).

As part of the discussion on information and support, I also asked the farmers what reaction they had received from neighbouring farmers concerning their transition to zero tillage or organic farming. More than half of the zero tillage farmers said they felt that their neighbours had a positive reaction to their transition, five felt there was a negative response, and four said there was indifference. Concerning local reactions, zero tillage farmers gave comments such as the following:

There's been a lot of resistance from the older generation of farmers around here. They like to see black soil, recreational tillage. Many farmers are too old to make big changes. You have to invest the capital or be willing to make payments on equipment. It's expensive (ZT-9).

My neighbours are sceptical. They're waiting for me to go under (ZT-10).

There's been tremendous interest locally, over 100,000 acres of zero till in the past 10 years. It's a hot spot. Farmers change because they've seen it work on their neighbours' farm, not because of the results on research plots (ZT-1).

There's growing support all over Saskatchewan. It's the zero till capital. We're ahead of Alberta and Manitoba (ZT-7).
A similar number of the organic farmers felt the reaction from their neighbours was negative, positive or curious. These are some of the comments given by organic farmers:

I'd say there's a certain amount of hostility in the area. They don't like the weeds in my fields (O-16).

People are curious, but I can't see it becoming too popular. People are hooked on chemical intervention. They want to be in control of nature. Organic farmers want to work in harmony with nature. It takes a certain kind of individual to farm organically. You have to be able to let go (O-3).

Some people are curious. Maybe if I had a $250,000 house, nice bins in a row, and expensive machinery, more might take notice (O-2).

A lot of farmers are afraid of the changes happening in agriculture. They don't think organic farmers are so nutty anymore (O-17).

I've found the neighbours to be very interested and respectful. We have some very long practising organic farmers in the area. I've been lucky. I've had very good support from them (O-1).

A small number of zero tillage and organic farmers responded that they “didn't care what the neighbours thought,” their decisions were based upon their own assessments, values and goals. One organic farmer added, “to challenge the status quo you have to be a strong individual, confident and experimental” (O-9).

5.2.3 Commitment to an Alternative Farming Practice

I asked the farmers to describe the extent to which they were committed to either zero tillage or organic farming practices (Table 5.3). Two-thirds of the zero tillage farmers reported they were fully committed to zero tillage management.

Zero tillage is the only thing in farming that's really excited me. It's a real challenge. It's fun to be current. The concept is an easy sell. It's good for the pocket book and good for the soil (ZT-5).

I'll stay zero till. The positive outweighs any negative aspects. Inputs have definitely increased. I've kept close tabs on it for quite some time, but I felt it was acceptable. Our herbicide use here is minimal in comparison with most other intensive farming systems, like the USA corn belt (ZT-1).

Zero till is working for us. We're resolved to high-input intensive agriculture, but we'll always stay within regulatory boundaries. I don't have a problem with many of the chemicals I use, especially Roundup. It's extremely safe. But it's always best to be flexible in farming and do what works (ZT-11).
One-third of the zero tillage farmers said they were conditionally committed to zero tillage, due to economic considerations and their concerns about the use of agrochemicals. These are some of their comments:

Chemical prices have to stay in line for me to stay zero till. Herbicide resistance also scares me (ZT-12).

I’m very concerned about chemical use. I’m very careful with handling and application. If there was any evidence that zero till was harmful either environmentally or to health, I’d quit. I don’t like spraying. It’s the last thing I want to do, but I have to (ZT-13).

I’d like to be a zero till-organic farmer. I’ve read it’s a possibility (ZT-1).

Unconditional commitment to organic farming was very high (91 percent). These are some of the comments from those farmers:

I’m locked into organic for good. I’d like to see everyone organic (O-18).

I’m going to stay organic and keep working on a sustainable system, from the soil to my family (O-19).

Those less committed to organic farming said staying organic was dependent upon the economic feasibility.

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<thead>
<tr>
<th>Commitment</th>
<th>Zero Tillage</th>
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5.2.4 Goals

Farmers were asked to describe their goals for various aspects of their farming operation and other personal aspirations related to farming. Their responses are examined in the following sections.
5.2.4.1 Size and Diversity of the Farming Operation

One-third of the zero tillage farmers said they would be increasing the size of their farming operations. Another one-third said they would be keeping the same farm size and some of these were considering diversifying the farm operation. Two of the zero tillage farmers said they would be decreasing farm size in order to "pay more attention to the details and add value instead of size." The other zero tillage farmers interviewed were not certain if they would or would not be making any changes to the size of their operations.

Nine (27 percent) of the organic farmers said their goal was to keep the same production base, and in some cases to diversify into processing and marketing. Similar numbers (5 or 15 percent) said they planned to increase farm size or to decrease farm size. One of those wanting to decrease the production base commented:

I want to spend more time on conservation methods: decreasing tillage, planting trees, row cropping, increasing crop diversity. I want to build a model of a diversified, low-input and relatively small-scale system (O-19).

A large proportion of the organic farmers (14 or 43 percent) were not certain if they were going to be making any changes in farm size in the future.

5.2.4.2 Environmental

Both zero tillage and organic farmers expressed a desire to improve environmental quality in their farming systems through more sustainable practices. For most zero tillage farmers, the focus was on decreasing soil erodibility and improving overall soil quality through soil conservation techniques. Improving soil quality was also important to many organic farmers, but they were less specific as to how they would achieve this. Increasing and improving wildlife habitat was also important to some organic and zero tillage farmers. Planting shelterbelts, reducing tillage operations, preserving wetlands were identified as ways to achieve this goal by both zero tillage and organic farmers. Eliminating the use of agrochemicals was also identified by organic farmers as a way to preserve wildlife populations. Improving water quality through the elimination of agrochemical use was also identified as an important factor in improving environmental quality by three of the organic farmers.
5.2.4.3 Intergenerational Transfer

Farmers were asked if their farming operation would continue to be owned and operated by family members in the next generation. Over fifty percent of the zero tillage farmers (17) and organic farmers (16) said they were confident the farm would be staying in the family. One of these zero tillage farmers said the farm would remain in the family as part of a Land Trust.

Seven (21 percent) of the zero tillage operators and four (12 percent) of the organic operators said the farm would definitely not be staying in the family, as there were no children or family members available or willing to take over. One zero tillage farmer said he would not let his children farm because of the economic risk involved in farming. One of the organic farmers said that although none of his children would be farming, he didn't want to sell the farm and was investigating establishing a Land Trust in order to keep the farm organic.

Nine (27 percent) of the zero tillage farmers and 13 (40 percent) of the organic farmers were uncertain about the future ownership of their farms as their children were still young. One of these zero tillage farmers commented:

It is hard to predict what will happen with the farm. I've made provisions to be able to give the land to the kids. But I'm not sentimental about the land. Farming had been very good to us. I'm not discouraging my kids from farming but I'm not taking great efforts to teach them (ZT-13).

5.2.4.4 Personal

Zero tillage and organic farmers identified many similar personal goals related to farming: continue farming, not have to work off-farm, contribute more to their rural community, continue learning and experimenting, spend more time with their family and be part of a farm co-operative. These are some of the comments of the zero tillage farmers regarding these goals:

I'll do whatever is necessary to sustain a rural way of life. For many families it means off-farm work and the deterioration of family life. I hope it doesn't come to that for us (ZT-11).

I'll try to keep learning. There's a lot of ground to cover in farming (ZT-14).

I'd like to make more of a contribution to our community (ZT-4).

This is the mission statement for our farm: is to be a family farm, to be good stewards of the land and to be good members of the community (ZT-8).
I think farm co-operatives, like the Matador, are excellent ideas and I would like to be part of one. But the idea isn’t that popular right now because of all the individualism (ZT-6).

The organic farmers had these comments:

I want to keep farming. It’s a decent way to make a living and a life. What else is there ((O-20)?

I’d like to see more community co-operative farming. There’s a synergistic effect of working with other farmers (O-14).

I’d like to keep experimenting. My dream is to some day turn this farm into an organic research station (O-19).

I like to do new things, things that are different. I’m not afraid of going against the stream (O-21).

Self-sufficiency and diversification were additional goals identified by organic farmers.

I’d like to be as self-sufficient as possible, to live simply and have our basic needs met (O-9).

I’ll be diversifying more, getting into processing and marketing, and maybe ecotourism (O-5).

5.3 Perceptions of Sustainable Agriculture

Each farmer was asked to explain what sustainable agriculture meant to them, and if they thought zero tillage and organic farming were compatible with sustainable agriculture. There were many interesting and insightful comments. Although there was a clear division between some of the organic and zero tillage farmers regarding the sustainability of these alternative practices, there were more commonalities than differences in the basic views of these two groups of farmers on the subject of sustainable agriculture. Three conceptual frameworks were abstracted from their responses:

- *Uncertainty and/or cynicism about the meaning of sustainable agriculture*
- *Sustainable agriculture is equated with sustainable farming*
- *Sustainable agriculture goes beyond the farm gate*

*Uncertainty and/or cynicism about the meaning of sustainable agriculture*

Twenty-five percent of the farmers interviewed said they were not sure what sustainable agriculture meant. Some of these farmers indicated they thought the term was ambiguous and could mean different things to different people. A few farmers were cynical about the use of the word. They
questioned who and what were to be sustained as they felt the term was being manipulated by dominant players in agriculture. These were some of the comments of the zero tillage farmers who shared this perspective:

Sustainable agriculture gets to be an overused term. Everybody's got their own definition. I don't really know what it means (ZT-12).

Everyone's got their own definition of sustainable agriculture, but when it comes right down to it farmers have the most at stake. The government bureaucrats should think about that (ZT-15).

I've heard sustainable agriculture mentioned at some of the meetings. There's a lot of talk, but not too much concern for farmers in the talk. I'd like to think zero till fits into sustainable agriculture. Organic farming doesn't work. There's no adequate method of weed control (ZT-16).

Some of the organic farmers had this to say:

There's a lot of different meanings for sustainable agriculture. I'm cynical about the way the word has been used and about the way the food system works. Big business runs the show. People's perception of sustainability can easily be swayed by advertising, constant messages from large companies (O-10).

Who and what are we sustaining? This is agri-culture, not agri-business. I'm very concerned about rural communities and about the environment. We can't control nature. Most people only look at one or a few parts and then manipulate them without knowing the connections between the parts or the effects. Sustainability is a long-term project. We need more than a three-, five-, or a ten-year window (O-4).

*Sustainable agriculture is equated with sustainable farming*

A large proportion of the farmers (65 percent) equated sustainable agriculture with sustainable farming. Different farmers emphasized the importance of different aspects of farming systems to sustainability: the family farm, soil and environmental quality, yields, farming practice, economic factors. A few farmers spoke of the development of sustainable agriculture/farming as a complex and long-term process, requiring attention to soil quality and soil fertility, diversity of farming conditions, and self-sufficiency.

Among the organic farmers the following aspects were emphasized: family farms (decentralized production units), reducing the reliance upon external purchased inputs and improving on-farm resources (independence), and working in harmony with nature. Although most of the organic farmers believed that reduced tillage and summerfallowing were important for improving soil quality, they believed that this
could be accomplished without the use of agrochemicals, through increasing the length and diversity of rotations, incorporating legumes in rotation, and by using other biological and cultural method of weed control. Organic farmers made the following comments concerning some of these topics:

**Family Farms:**

Sustainable agriculture starts with economically viable family farms. The survival of the family farm is critical to sustainable food production around the world (O-22).

**Reducing Dependence on External Inputs and Improving local resources:**

Sustainable agriculture means doing your best to decrease inputs and improve local resources. I think a good organic system is the ultimate. It can be done and it is profitable. We're very proud of what we are doing. We post signs indicating organic crops are being grown here. We think we're on the road to sustainability (O-23).

Sustainable agriculture means leaving the land better. Taking care of the land with stewardship and living on it and enjoying it (O-11).

**Growing crops in harmony with nature:**

Sustainable agriculture is about growing crops in harmony with nature. We need to be aware of what we are doing to the earth. We have to keep an open eye on what science recommends or produces, its not always right (O-9).

**Farming Practice:**

Zero tillage is sustainable in that it keeps the topsoil, but isn't with its use of chemicals. There's a lot of zero till around here, mainly big farmers. They don't seem to be having problems yet, but just wait. Herbicide resistance is increasing and chemical costs are only going to get higher. Organic fits into sustainability, but it could be better (O-13).

**Sustainability is a goal to work towards:**

Sustainable agriculture is something we're going to have to work a lot harder at. No one has the solutions to declining soil quality and fertility. I believe that organic is the most sustainable approach we have right now, but there's also some good in zero tillage. We need to improve upon what we have and also be open to new possibilities (O-24).

The world is filled with ideals to which we might aspire. But even if we can't find the perfect sustainable farming system, it doesn't mean it isn't worth talking about and working towards. I think we need to be concentrating more on building more self-sufficient agroecosystems - recycling nutrients, more local production and local consumption, improving human and land resources (O-14).

Zero tillage farmers emphasized the important role of family farms, commodity prices, increased yields, soil quality, local diversity, and integrating environmental and economic goals in the development
of sustainable agriculture. These are some of the comments of zero tillage farmers who equated sustainable farming with sustainable agriculture:

**Family Farms:**

Family farms are definitely part of the picture for sustainable agriculture. Bigger farms are a fact of life now, but family farms are here to stay. It is a good life. Farming is so real and food is so real (ZT-5).

**Economic Factors:**

Consumers need to pay for the cost of their food. If we could get a decent price, we could farm right (ZT-17).

Sustainable agriculture is hard to define. But what effects us more than anything are prices. Environmental regulations may go too far. There's a romantic version of nature out there, just try living in nature (ZT-18).

**Improving soil quality:**

It means leaving the land in a useable state, replacing what we take. A lot of farmers don't realize they're creating a deficit. Zero till is contributing to sustainability. It's suitable for the prairies. Soil is an extremely precious commodity and we know very little about taking care of it. If we don't become more sustainable with it, we're going to pay for it in the long run (ZT-1).

It means sustaining soil for the next generation. It's more about land quality than about farmers on every quarter. Farming is a responsibility not a right (ZT-19).

**Farming Practice:**

We're trying to farm sustainably, trying to improve the land through zero tillage. I don't want to mine the land, I hope we're not doing that. I give moral support to organic farmers, but I don't want my fields to look dirty. But if problems with chemical use surface, I would probably go organic (ZT-13).

Organic farming is interesting, but it's too labour and management intensive for large-scale farming. The rotation work of organic farmers has helped all farmers (ZT-11).

**Responding to Local Diversity:**

The motherhood statement of sustainable agriculture is very general, but to implement it is much more complex because of the diversity of farming conditions. The more grassroots the focus of our efforts, the better in maintaining and working with that diversity. But the more government downsizes, to cut costs, the more difficult to be in touch with the diversity. Also farmers aren't receptive to being told what to do. The more personal contact researchers and policy makers have with farmers the better. It's better for farmers to see the need to take responsibility for the land than to be forced to do it by bureaucrats (ZT-11).
**Increased Yields:**

Organic farming simply doesn’t work. They have decreased yields. If everyone was organic a loaf of bread would cost 10 dollars. Chemicals bring the cost of food down. They (organic farmers) are just chemophobics. What Avery has to say makes a lot of sense. We need to keep increasing yields to feed the world (ZT-20).

**Combining Economic and Environmental Goals:**

For me, it means being able to farm on an on-going basis, remaining economically viable without depleting resources. The technology (zero tillage) is here but farmers need to fine-tune it to make it work on their own land. Farmers won’t disappear. The technology can’t make decisions for you. Farmers are independent, want to do their own thing. They love their lifestyle (ZT-21).

It means farming in tune with the land -finding ways to balance the equation both economically and environmentally. Most farmers are more concerned about getting out of debt and surviving. They haven’t really changed the way they farm (ZT-22).

**Sustainable agriculture goes beyond the farm gate**

A smaller percentage of farmers (approximately 10 percent) shared the view that sustainable agriculture went beyond the farm gate. One zero tillage farmer said:

> You have to view sustainability on different levels, from production through to consumption. We have to deal with the most pertinent problems first, then go to the next. We can’t have nirvana right now. It will be a long process (ZT-1).

These are the comments of two organic farmers:

Sustainable agriculture is more than about minimizing soil erosion or improving soil fertility, through the use of Roundup and other chemicals, it’s about taking account of the whole picture. We should also be working towards closing the urban and rural gap. It will require a lot of changes (O-25).

Sustainable agriculture is about a way of life. It is when the whole agricultural system works together for the next generation (O-21).

**5.4 The Future of Farming in Saskatchewan**

The farmers were asked to make predictions about the future of farming in Saskatchewan based on their experience and observations as farmers. I suggested general topics they might address (farm size, types of farming enterprises, farming practices) but I encouraged them to include any topics or issues they felt were relevant.
Many of the zero tillage and organic farmers interviewed were pessimistic that the general trends of increasing farm size, increases in the amount of rented land, declining number of family farms and rural communities would continue.

I’m loosing optimism about farming. I’ve been farming 41 years and over the past 10 years there have been more changes than over the previous 30 years. And there are a lot more changes coming. Farmers have to adapt fast. They have to have the resources to adapt. The smaller, less educated farmers are going to lose out (ZT-23).

The rising cost of inputs, low commodity prices, government agricultural policies (including the cheap food policy) and globalization were identified as the key external factors influencing these structural and social changes in Saskatchewan farming communities. These are some of the comments from zero tillage farmers on future trends in farm size and types of farming enterprises and the factors shaping these trends:

Farms will have to get bigger. I don’t like it, but machinery and chemical costs are so high, and prices are so low, you have to go big to be viable. The small guys can’t compete. It’s now very feasible to farm very large acreages. There will be more and more rented land. There comes a point when you can’t look after that much land and do a good job. There’s no commitment or personal involvement with corporate farming (ZT-24).

Well, there’s definitely a trend to increasing farm size, but large farms aren’t the be all and end all. I don’t think corporate farms will take over, there’s not enough return on dirt. The government says we need agriculture in order to survive. Yet the policies don’t support local family farms. It’s better to pay more for locally grown food and support our farmers. Farmers need help to continue and to pass on their knowledge. We’re losing that knowledge (ZT-18).

Farms should stay family farms but they’re getting squeezed out by globalization trends. Only large operations seem to be able to survive. We’ll be looking at mass consolidation. There’s all this talk from the government about how diversification will save rural communities. So they open up factories and all the farmers will have to work in the factories to keep their farms going. It’s scary and getting worse. People are fooling themselves if they think things are getting better (ZT-25).

We have to get away from the cheap food policy. We need fair prices for our products and we need more young people in farming. I wouldn’t want to do anything else or live anywhere else. Rural communities are like one big family. People care about you (ZT-15).

There were similar comments from some organic farmers:

Farms and communities are disappearing and farmers can’t organize against it anymore. They’re worn out from struggling to survive. The government could put policies in place that would change these trends (O-20).
There's a need to grow food so there's going to be some kind of farming around, but I don't want to predict what it will look like. Probably something I wouldn't like. How much bigger can some of these guys get (O-26)?

Farms will keep getting bigger; the family farm is threatened. The government is pushing for bigger farms. But this is no way to maintain the community or the land (O-17).

There's a major adjustment taking place in agricultural policy here as a result of changes in the world economy. There's less and less support for local producers (O-9).

For some reason, those in power think mega-farms are the way to be efficient. But there's a point at which you're not efficient or sustainable. If family farms disappear the system will collapse (O-19).

One organic farmer explained why he thought the current trends should be reversed, to an increasing number and a decrease in the size of farming operations.

Farms should be getting smaller, supporting more families. The government needs to help make that happen. It's crazy to put more people in the cities on welfare. Five hundred acres should provide a good living for a medium sized family (O-2).

Another organic farmer asserted that farmers had to stop thinking of themselves as victims of external forces and become aware that by failing to critically assess and resist the dominant industrial model in agriculture they were contributing to the detrimental trends occurring in rural Saskatchewan.

Many farmers continue to believe that they should maximize production. What's the point of pushing production and yields through increasing chemical use when prices stay low and there's environmental and health risks (O-4)?

Some zero tillage and organic farmers predicted that although the size of grain farms would be increasing and the number would be decreasing, there were also going to be more opportunities for smaller-sized family farms catering to various niche markets. A few zero tillage and organic farmers predicted a significant increase in the number of farms operated as partnerships and co-operatives.

A smaller proportion of the farmers expressed optimism about the future of farming in Saskatchewan. Some zero tillage farmers based their optimism for the future on the projections for increasing demand for food due to a growing world population. Other zero tillage farmers were enthusiastic that technological advances, in genetic engineering, non-residual herbicides, satellite imaging technology and computerized equipment, would facilitate positive changes in farm labour and management, as well as economic and environmental sustainability of farms in Saskatchewan.
I'd say the future looks bright for farming in Saskatchewan. We've got genetic engineering and safe chemicals like Roundup. The family farm will live on, but it will have to be flexible and adapt (ZT-26).

The technological changes in agriculture will be phenomenal. I'll just sit in the house and let the machinery drive itself (ZT-10).

Some of the zero tillage and organic farmers were hopeful about the future due to the greater number of farmers that recognized the problems in conventional agricultural practices and were seeking ways to make changes. Many zero tillage farmers were confident that more and more farmers would be moving to zero tillage or other conservation tillage practices.

There will be some kind of decreased tillage. It's just a fact. The way we were going was a no-win deal (ZT-5).

Conservation tillage is here to stay and I hope that everyone eventually swings to zero tillage. The only downside to zero till is it makes it possible to farm very large acreages, 2500 to 3000 acres are the norm (ZT-23).

One farmer said that the biggest factors determining the future adoption of zero tillage in Saskatchewan would be "the cost of equipment and Roundup." Other farmers commented on future trends for the use of agrochemicals.

Chemical use is going to increase. Roundup seems safe, but I'm worried about some others. Also (genetic) resistance could be problem (ZT-13).

We've come through the chemical age. Now we're going to have to look at the whole system (ZT-1).

Most of the organic farmers were optimistic that there would be increases in the adoption of organic farming practices. Some also said zero tillage and the use of agrochemicals would increase.

These are some of their comments:

I see a good future for organic agriculture. We use fewer inputs and less expensive machinery, to begin with. Also there are premium prices, increasing markets and Saskatchewan is perceived as a very clean environment. But we need help agronomically. There hasn't been that much interest in helping us out with the research (O-27).

There are two paths in farming, one economic and the other environmental. Most modern farmers are preoccupied with economics. They don't ever touch the soil. I feel that everyone will farm organically eventually. Some will chose; others will be forced to (O-11).

Environment, economics and health will eventually dictate how people farm and what food they buy. I don't think zero till can work in the long run. The jury is still out on the long-term effects of chemical use (O-28).
If the information on organic was more visible, more accessible, more and more farmers would see it is possible to farm with few inputs (O-24).

Zero till will get really big, there’s a lot of promotion going on. Less tillage is the way to go, but there should also be more forages and plough down, not more chemicals (O-19).

Zero tillage is good for the soil but so is a good organic rotation (O-29).

Some of the organic farmers stressed how important it was for those committed to a truly alternative organic food system to retain local control over organic standards, production, processing and marketing and resist the trend to consolidation and corporatization occurring in the conventional agrifood system.

There is increasing interest in organic agriculture from consumers and also from big corporations. The farmers need to remain in control. We may lose the concept and the philosophy of organic if it gets taken over by corporations, like is happening in California (O-21).

I’d like to see the government stay out of the way. Even if we’re lacking in research and other areas, we have more control over everything right now (O-1).

5.5 Gender Issues

Research on sustainable agriculture has investigated both the material and ideological conditions that accompany the transformation to more economically, socially and environmentally viable production practices, but there has been relatively little attention paid to gender relations in the discourse on sustainability. Chiappe and Flora (1998) and others (Kloppenburg (1991), Flora (1992), Feldman and Welsh (1995) make the case for considering the implications of gendered ways of knowing for sustainability.

Both the material conditions of farm women, particularly where there has been a traditional division of labour within the household, and the ideology present in most farm communities will lead them to frame sustainability differently than men do, even when they share an overt commitment to move towards a more sustainable agriculture and world….Because women seldom have direct access to, or control of, privately held resources, they are more likely than men to be attuned to common resources and their condition. Even when women do have legal ownership of land, they are less likely than male owners to make the decisions on how that land is used. Women’s responsibilities in the domestic sphere give them a different vantage on sustainability. However, women’s limited access and control over resources – financial, manufactured, human, social and environmental – often limits their ability to put their values into practice (Chiapppe and Flora 1998: 373).
Many of the farm women I met while visiting the farm households in this study had similar concerns about food production and consumption that appeared to be linked to their roles in farm households and in rural communities.

Women have always played important, productive roles in family farm enterprises in Saskatchewan. In addition to their primary responsibility for domestic work (e.g., cleaning and washing, food preparation, child care, gardening) and involvement in various aspects of the farm work, a large percentage of farm women are also now engaged in off-farm jobs. Despite their important contributions to the farm unit, studies have shown that women’s role on the farm is often rendered invisible by the focus on work done by men in production (Chiappe and Flora 1998, Kubik and Stirling 1998, Lerner 1986). The social significance attributed to gendered roles in farming reflects the fact that patriarchy typically reigns on the family farm and in rural communities (Kubik and Stirling 1998). In general, men are the primary property owners, they make most of the major decisions in the farming operation, and they hold more prominent leadership roles in agricultural and community organizations than women. But, as Lerner (1986) points out, as a result of the fusion of the household and the farming enterprise, women are not powerless and without influence and resources.

Kubik and Stirling (1998) identify two ways in which the traditional patriarchial structure is challenged, providing opportunities for farm women to gain power and influence on the farm and in their communities. The more contemporary way is for farm women to move into positions that give them greater equality, either through off-farm employment or through increased involvement in the farm operation (e.g., taking care of the farm accounts). The other way is through the more traditional domestic and reproductive roles. Kubik and Stirling examine the role women have played in maintaining and restoring health, not only in the family, but also in the community. They point out that “medical knowledge was historically, in large measure, women’s knowledge” (Kubik and Stirling 1998: 16). They were the healers and midwives, and were also involved in growing and preparing much of the food for their family. Although these roles have changed, with the advent of the formal health care system and increasing reliance upon purchased food, women are still the primary care givers in the home and in the community. Child care, food preparation, and care of the elderly are still predominantly the responsibility

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of women in rural communities. These family and community sustaining roles give women opportunities to gain authority and power.

In this study the dominance of men in the realm of commodity production was apparent. Although a number of women were occupied with off-farm jobs and could not be present during the interviews, the majority of the women who were present declined to be involved in parts of the interview dealing with technical aspects of the farming operation. The reasons for the involvement of a higher proportion of women from organic farms in these discussions were not investigated in this study. However, Barlett (1993) and Salamon (1992) found women more intensively involved in small-scale, low-input, more diversified family farming operations than on those farms that were large-scale, more industrial-like operations, suggesting that the former provided more opportunities for women to have their concerns and preferences influence farm management decisions.

More women were involved to a greater extent in the parts of the interviews that dealt with reasons for making the transition, goals and perceptions of sustainable agriculture and the future of farming. Women's comments in response to these questions did not differ significantly from their male counterparts and have been included in preceding sections. During informal conversations with some of the women which took place privately either before or after the formal interview, and from my personal observations, there appeared to be one issue that was of primary concern to women. Women from both organic and zero tillage systems expressed concern about the health risks for their families and their neighbours associated with increased use of agrochemicals. Some said they believed there was an association between the use of pesticides and increases in allergies and cancers in their communities. One woman from an organic farming operation in south-central Saskatchewan said that a few years back, when farmers in the area were spraying with an insecticide to combat an outbreak of grasshoppers, women in the community reported increased numbers of miscarriages. Another mother of seven children told me the tragic story of how one of her sons had died as a result of internal hemorrhages due to lethal exposure to an insecticide. She was aware of the fact that I was pregnant and was worried about me being exposed to chemical sprays while I was out interviewing. She said she didn't like that fact that they continued to use pesticides on their farm but that her husband would not farm any other way.
One female small-scale organic herb grower raised other concerns about the conventional approach to food and medicine production.

The care factor in food and medicine production is extremely important. The type of energy and spirituality put into the growing and processing affects the quality of the food and medicine produced. Food that is mass produced and grown with chemicals can’t be good (O-30).

By growing and preparing food and medicine on a small-scale, using her labour and management skills in place of industrial inputs, she said she was only doing what she thought was right. By being involved in this type of farming operation, and as a single female operator, this woman was resisting conventional structures and approaches to agricultural production.

Other women from more traditional farming operations and in more traditional roles were also engaged in forms of resistance. On several farms that I visited I was given a tour of the garden. During the tours I would ask if they used any inputs on the garden, such as livestock manure or agrochemicals. Whether or not the farm was under zero tillage or organic management, all the gardens I saw were “chemical-free.” On these farms the garden was primarily the woman’s responsibility. By gardening without chemicals the women said they felt they were providing healthier food for their families. Although men dominate in the realm of commodity production, women tend to make the decisions and have control over the growing, processing and purchasing food for the members of the household. One male organic farmer and processor told me the following story about the gendered attitudes towards agrochemicals and organic food in his community:

A lot of women in the area come to buy our organic cereals and pancake mixes. Meanwhile their husbands’ are at home spraying like a son of a bitch. Men should smell the flowers. Women are intuitively smarter. They know what happens when their kids eat healthy (organic) food (O-4).

It is evident that the use of agrochemicals, in both large-scale (export) production and local production and consumption (vegetable and fruit gardens and locally produced and processed grains), was an important issue for many of the farm women in this study. This concern was linked to their reproductive and domestic roles in family households and rural communities. Invoking the authority and legitimacy conferred by these roles, they made choices that they believed to be more compatible with the health of their families and their communities.
5.6 Summary

Farmers in this study adopted an alternative farming practice in response to problems they encountered with conventional agriculture. Environmental concerns were identified as the primary reasons influencing the transition to both zero tillage and organic farming, but the nature of these and other concerns differed for the two groups of farmers interviewed. Zero tillage was adopted as a way to improve soil quality by eliminating tillage and summerfallowing, as well as to gain economic and labour advantages. The impact of agrochemicals on the environment, wildlife, and human health were identified as major concerns by the organic farmers. Organic farming also appealed to these farmers for economic, philosophical/spiritual and labour reasons. Commitment to continue practicing organic farming was extremely high in this sample. A smaller proportion of farmers indicated that they were strongly committed to zero tillage. Economic factors were a consideration for all farmers conditionally committed to an alternative practice, and concerns were also raised by zero tillage farmers about increased reliance on agrochemicals.

Both zero tillage and organic farmers relied on many of the same sources of information and support, but there were significant differences in the relative importance of these sources to the two groups of farmers. There were also some sources referenced exclusively by either zero tillage or organic farmers. In general, the zero tillage farmers were satisfied with the institutional and organizational support available to them, and said that their transition was viewed positively by neighbours and family. Organic farmers felt that they had received little institutional support, particularly in the areas of research and extension. Reactions from neighbours regarding their transition to organic farming ranged from positive, negative, to indifferent.

Commonalities were evident in farmers’ goals and basic views on sustainable agriculture, but there were also important differences in the ways these two groups of farmers translated these ideas into practice. Being able to continue to farm, keeping the farm in the family, spending more time with family and developing better land stewardship were goals shared by both zero tillage and organic farmers. A higher number of zero tillage farmers said they wanted to increase the size of their farming operation, but a similar number of zero tillage and organic farmers said they intended to diversify the farming operation.
The highest proportion of farmers equated sustainable agriculture with sustainable farming. A small number of farmers viewed sustainability within the larger agri-food system. One-quarter of the farmers interviewed were uncertain or cynical as to what sustainable agriculture meant. Most farmers were pessimistic about the overall future of farming in Saskatchewan, primarily due to the negative impacts of external economic and political factors. Some zero tillage farmers believed that zero tillage and other technological advances, as well as increasing global demands for food, were creating a positive future for agriculture in the province. Organic farmers were optimistic that organic agriculture would eventually occupy a prominent position in agriculture due to growing awareness of the problems associated with high external input approaches to agricultural production.

Although the influence of gender on farmers’ perception and responses to sustainability was not a major focus in this investigation, women in this study did appear to share heightened concerns about the impact of agrochemical use on human health. Although some of these women were unable to influence changes in the use of farm chemicals in farming practice, in the domestic realm (e.g., gardening, food purchasing and preparation) women were able to act upon their concerns and make choices they believed would sustain the health of their family.
CHAPTER SIX: EVALUATING ZERO TILLAGE AND ORGANIC FARMING SYSTEMS AS LOCAL RESPONSES TO SUSTAINABILITY

6.1 Introduction

In the two preceding chapters, data concerning both the practical and ideological/theoretical aspects of organic and zero tillage farming systems were presented. In this chapter I evaluate these farming systems as local responses to sustainability. First, the advantages and disadvantages of zero tillage and organic farming are compared according to environmental, economic and social variables identified in this study. Based upon this comparison, I then analyze how these two types of systems fit with dominant and alternative paradigms of sustainability. In the final section, the compatibility between farmers’ theories of sustainable agriculture and their farming practices is examined.

6.2 Comparing Social, Economic and Environmental Aspects of Zero Tillage and Organic Farming Systems

Most studies comparing the sustainability of different types of farming systems focus on specific environmental and economic variables. The variables commonly analyzed in these studies include productivity, profitability and selected environmental impacts (soil and water quality, biodiversity and pest dynamics). Social criteria are relatively neglected, but, I argue, are equally important to agricultural sustainability, and are strongly linked to ecological and economic variables. In this section, I compare and examine the sustainability of zero tillage and organic farming with reference to all three of these complex and interacting dimensions (Table 6.1).
<table>
<thead>
<tr>
<th>Environmental Advantages</th>
<th>Zero Tillage</th>
<th>Organic</th>
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<tr>
<td>-practiced in all SCZ</td>
<td>-practiced in all SCZ</td>
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<tr>
<td>-improves soil quality by eliminating tillage and falling, thereby increasing crop residue on soil surface</td>
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<td>-increased crop diversity</td>
<td>-improve soil quality by:</td>
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<td></td>
<td>• diversified/extended rotations</td>
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<td>• use of legumes in rotation</td>
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<td>• nutrient recycling</td>
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<td></td>
<td>• other biological and cultural methods</td>
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<td></td>
<td>-decrease risk to soil and water quality, wildlife by eliminating fertilizers and pesticides</td>
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<td>-increased diversity (crop and livestock)</td>
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<td></td>
<td>-decreased overall use of fossil fuels</td>
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<td>Disadvantages</td>
<td>-not well suited to heavy clay soil and poorly drained soils</td>
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<td></td>
<td>-increase risk to wildlife and environmental health due to increased use of agrochemicals</td>
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<td></td>
<td>-herbicide resistance associated with increased reliance upon herbicides</td>
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<td>-specialized for crop production</td>
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<td>-increased overall use of fossil fuels</td>
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<td></td>
<td>-excessive use of tillage and fallowing, can result in degradation of soil quality</td>
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<td>Economic Advantages</td>
<td>-decreased fuel costs</td>
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<td>-decreased machine inventory</td>
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<td>-decreased labour time</td>
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<td>-increased crop diversity/flexibility</td>
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<td>-eliminates agrochemical costs</td>
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<td>-premium organic prices</td>
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<td>-suited to crop, livestock, and mixed operations</td>
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<td>-scale-neutral (small to large-scale production)</td>
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<td>-economies of scope¹</td>
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<td>Disadvantages</td>
<td>-increased cost of agrochemicals</td>
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<td>-high cost of equipment</td>
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<td>-low commodity prices</td>
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<td>-drop in yields during transition</td>
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<td>Social Advantages</td>
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<td>-promotes farmer networking</td>
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<td>-decreased health risks</td>
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<td>-high involvement in community and agricultural organizations</td>
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<td>-more moderately sized, diversified farms</td>
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<td>-high degree of ownership</td>
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<td>-labour exchange</td>
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<td>-promotes farmer networking</td>
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<td>Disadvantages</td>
<td>-increased health risks</td>
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<td>-facilitates increased farm size, consolidation</td>
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<td>-increased proportion of rented land</td>
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<td>-low support from agricultural science and industry</td>
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<td>-not well researched, documented</td>
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<td>-marginalized within agri-food system farmers labelled as unprogressive</td>
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¹. Economies of scope refer to economic advantages that may result from diversification, or the production of several different commodities. In farming this can include opportunities for greater income stability, more even distribution of labour demands, increased flexibility in cropping decisions in response to weather
6.2.1 Environmental

6.2.1.1 Suitability to Soil Climatic Zones

Zero tillage and organic farming practices are being adopted on farms located throughout the seven soil climatic zones in Saskatchewan. The organic approach may be more easily achieved in regions with higher moisture availability due to the emphasis on diversified crop rotations for pest control and for improving soil quality. Nevertheless, successful organic operations were also documented in the drier southwest region of the Province. Farmers’ selection of suitable crops for rotation and improvements in soil quality over time may account for the success of this approach in the drier zones. In contrast, zero tillage management is ideally suited to drier growing conditions and the adoption of zero tillage in Saskatchewan has been highest in the Brown SCZs of the Province. Increased retention of soil moisture in zero tillage systems enabled farmers in these drier regions to increase the productive potential of the land and to expand the range of crops grown. High moisture conditions and poorly drained soils are not well suited to zero tillage due to poor germination, slower decomposition of organic matter and higher potential for denitrification of nitrogen.

6.2.1.2 Soil and Water Quality

Concerns about the impacts of conventional agriculture on soil quality were identified as the primary factors influencing farmers to make the transition to zero tillage. By reducing and eliminating tillage and fallowing, these farmers reported achieving significant improvements in soil quality, specifically decreased soil erosion, increased soil organic matter and better soil tilth, and increased soil moisture. As a result of these improvements farmers viewed zero tillage as an effective way to contribute to environmental sustainability. For a large proportion of these farmers (approximately two-thirds), the increased reliance upon agrochemicals in zero tillage management was not perceived to be a threat to environmental sustainability. A smaller proportion of the zero tillage farmers (approximately one-third) did, however, express concern about the impacts of agrochemicals on the environment, particularly the increasing occurrence of herbicide resistance and potential threats to soil and water quality.

or market stimulus, and fuller use of on-farm resources (e.g. recycling nutrients – fertilizing with composted livestock manure or crop residues, labour, marginal land) (M. E. Gertler, personal communication).
Concerns about the impacts of agrochemicals on the environment and on human health were identified by the organic farmers as key factors motivating their transition to organic agriculture. By substituting a variety of biological and cultural practices for the use of synthetically produced fertilizers and pesticides, they claimed to maintain soil fertility, improve soil tilth, control pests and diseases, as well as reduce the risk to the environment and human health. Tillage was still a commonly used practice in the organic systems. Many farmers recognized the problems associated with this practice and were reducing the need for intensive and frequent tillage and fallowing operations by underseeding with clover, using allelopathic crops in rotation, and increasing the diversity and length of rotations. In approximately one third of the organic farms studied, fallowing was replaced by the use of a legume green manure crop in the rotation, although tillage is used to work in the residue.

6.2.1.3 Biodiversity

In comparison to the conventional wheat/fallow system, crop diversity was relatively high in most of the zero tillage systems and diversity tended to increase in the more moist SCZs. Farmers in the drier soil climatic zones reported that they were able to increase crop diversity as a result of increased moisture retention with zero tillage. Incorporation of livestock in these farming systems was, however, limited. This is not surprising given that zero tillage is a crop production technique that is ideally suited to specialized, large-scale operations.

Overall, biological diversity was higher for the organic farming systems. A wider range of conventional and specialty crops were grown, and both a variety and a significant number of livestock were included on a high proportion of the organic farms. The organic approach is applicable to crop and livestock operations, both small and large scale, and is ideally suited to mixed crop and livestock operations due to the increased potential for nutrient recycling and economies of scope.

6.2.1.4 Energy Use
Agriculture in Saskatchewan is highly dependent upon fossil fuels as an energy source for the manufacturing of agrochemicals, machinery and equipment, for various mechanized operations, and for the transportation of inputs and commodities to distant markets. In addition to contributing to the depletion of a non-renewable energy source, the use of fossil fuels in agriculture also contributes to carbon dioxide emissions, which impact on global climate. One of the most energy intensive aspects of Prairie agriculture is the manufacturing of nitrogen fertilizer. Organic agriculture avoids this energy cost by using legumes in rotation to fix atmospheric nitrogen and by recycling nitrogen in animal manure. Phosphorus is also recycled from animal manure and the use of legumes and certain other crops (e.g. buckwheat) in rotation also makes soil phosphorus more available (Rutherford et al. 1992). Fuel use in the organic systems was reported to be similar to conventional management.

Many of the claims made about energy savings with zero tillage are based upon savings of tractor fuel only, as the use of fertilizers and pesticides tends to increase and there is a need for specialized equipment and machinery. When all the costs are considered, the energy savings associated with zero tillage diminish considerably. According to Cacek (1984), even a moderate increase in chemical use in a zero tillage system can eliminate energy savings.

6.2.2 Economic

The zero tillage farmers reported savings in production costs due to decreased fuel costs and a decreased machine inventory. These cost savings were offset, however, by increases in the use of agrochemicals and the high capital costs associated with specialized large-scale equipment. Farmers unable or unwilling to make the large capital investment needed for the full-range of zero tillage equipment had higher operating costs (e.g., associated with hiring companies specialized in custom farm work, such as spraying). Decreases in labour time associated with zero tillage management enabled farmers to generate additional capital by either working off-farm or by expanding the size or diversity of their operation. Continuous cropping enabled them to increase the productive capacity of their land base and thereby increase their income. Zero tillage management was also identified as a way for farmers to increase flexibility in their cropping decisions and therefore enabled them to be more responsive to
changes in markets. The zero tillage farmers identified low grain prices in conventional markets as the major obstacle to achieving economic viability at the farm-level.

All the organic farmers reported significant reductions in their costs of production due to the elimination of synthetic fertilizers and pesticides. They also claimed to be saving money by not being dependent upon the latest developments in machinery and equipment. By reorganizing labour and management, many organic farmers were able to diversify their production and, in some cases, to diversify into secondary processing and marketing. Diversified farming systems are associated with greater income stability, more evenly distributed labour needs (which may be a contributing factor to lower use of non-family hired labour) and greater self-sufficiency in basic food needs. Premium prices for organic products were also identified as a significant economic advantage to organic producers. Despite such price advantages, a small proportion of the organic farmers (less than ten percent) were not convinced of the economic feasibility of this approach to farming and for that reason were only conditionally committed to the practice.

6.2.3 Social

Zero tillage is well supported by both the public and private sectors in agriculture. It has been validated scientifically (by conventional scientific processes of evaluation) and is consistently promoted as the most effective way to integrate economic and environmental criteria for farm-level sustainability. Zero tillage farmers are therefore typically classified as "progressive," "innovators," and "good operators." Although the industry and the state have become very involved in developing and promoting zero tillage in Saskatchewan, the role of farmers as initiators and developers of this practice is widely acknowledged. The SSCA highlights farmers’ accomplishments and encourages farmer to farmer networking through its various extension activities.

Most of the zero tillage farmers interviewed identified zero tillage as a very positive innovation for Prairie agriculture, particularly in terms of land stewardship, but concerns were raised by some regarding health and social impacts associated with this practice. As was mentioned, approximately one-third of the farmers were concerned about the potential health risks associated with increased use of agrochemicals. Another concern raised by a small number of zero tillage farmers was the effect this
practice was having on trends in land tenure and farm size. Zero tillage was considered to contribute to the decline in the numbers of family farms and to the demise of rural communities because it allows a farmer to farm more land. Although they did not view this trend as positive, many felt it to be inevitable given the economic pressures facing farmers. Zero tillage was, therefore, seen as a pragmatic choice that enabled them to make the necessary adjustments to their farming systems so as to meet changing economic and environmental criteria.

The organic farms tended to be more diversified and of more moderate scale, compared to the zero tillage farms examined in this study. Both the number and diversity of farms have been shown to be positively correlated with cultural diversity, employment, and business opportunities in rural regions (Klemme 1991). Other characteristics of organic farmers revealed in this study, including a high degree of involvement in community and agricultural organizations, and greater reliance upon labour exchange with relatives and neighbours, suggest that organic farming makes relatively important contributions to the formation and reproduction of social capital. A high degree of ownership was also characteristic of the organic farms, and ownership has been linked with land stewardship (Belcher 1999). By eliminating the use of synthetic fertilizers and pesticides, the organic farmers also believed they were reducing the health risks to themselves, their families, their communities and consumers. Organic farmers rely more on personal experience and sharing information with other farmers than on the technical knowledge of agricultural institutions and input suppliers. These characteristics involve organic farmers in developing local knowledge and skills, and in the building of farmer networks (Flora 1995).

Despite rapidly increasing consumer demand for organic products, organic agriculture remains a small sector within the overall agri-food system. In Canada, organic farming and the organic movement continue to receive little attention within mainstream agricultural institutions and, therefore, have not been extensively researched. The general view persists within these institutions that organic farmers are zealots and that organic farming is unprogressive an ineffective method of production.²

² Although I am not aware of any recent survey of attitudes among university, government, and industry scientists, there is much evidence in the mainstream scholarly and trade literature that organic agriculture is only lately winning limited recognition as a legitimate approach.
6.3 Adherence to Dominant and Alternative Paradigms of Sustainable Agriculture

Dunlap and Beus (1991) maintain that fundamental differences in regards to perceptions of sustainable agriculture can be attributed to adherence by individuals to either the dominant or to an alternative social paradigm. The key elements of the dominant and alternative paradigms for agriculture, as identified by Beus (1995), were presented in Chapter Three, Table 3.3. Centralization, dependence on industrial inputs and expert advice, competition, domination of nature, specialization, and exploitation are the characteristics identified for the dominant/industrial paradigm of agricultural development. In the alternative paradigm, decentralization, independence, community, harmony with nature, diversity and restraint are emphasized. The case was made in Chapter Three that zero tillage fits within the dominant paradigm of agricultural development, whereas the characteristics of organic agriculture correspond more with the alternative paradigm advanced by much of the sustainable agriculture movement. Based upon the field evidence presented in preceding chapters, it is possible to evaluate how closely these farming systems and farmers’ perceptions of sustainable agriculture adhere to the dominant and alternative agricultural paradigms identified by Beus (1995).

6.3.1 Centralization versus Decentralization

Within the dominant agricultural paradigm, centralized control of land and resources is perceived as the most effective way to increase output and efficiency of production. Increasing scale of production and consolidation throughout the agricultural system is therefore viewed as an inevitable outcome of scientific, technological and economic progress. This perspective suggests a survival of the fittest; only the largest and most economically efficient operators will survive. Zero tillage is associated with larger operations and an economies of scale approach that is compatible with the dominant paradigm.

Proponents of the alternative paradigm argue that increasing consolidation in agriculture is not a positive development nor is it sustainable, economically, ecologically, or socially. They call for a relocalization or decentralization of agriculture in order to create more ecologically and economically self-sufficient and sustainable agroecosystems. Organic farming is compatible with the concept of smaller and more self-sufficient farming systems, as it is ideally suited to mixed crop and livestock production. There are, however, aspects of organic production in Saskatchewan that do not correspond strongly with
the alternative model described by Beus (1995). Organic farms in this study were, on average, of smaller size that the zero tillage farms, but slightly larger than the average farm in the Province. Organic processing and marketing was relatively decentralized in Saskatchewan at the time this field work was carried out. Some of the organic farms examined were involved in local or on-farm processing of their products and most of the marketing of organic products was handled by individual producers, local brokers, or through local marketing co-operatives. Most organic products grown in Saskatchewan were, however, destined for long-distance markets, predominantly in Europe, Japan and California.

6.3.2 Dependence Versus Independence

Reliance on scientific and technological innovations, and the use of fossil fuel-based sources of energy and credit are viewed within the dominant paradigm as essential to the goals of productivity and economic growth. Knowledge generation and transmission in this model is predominantly hierarchical. Innovations developed by industry and public institutions of agriculture science are identified as progressive and beneficial, and therefore should be adopted by farmers. Within the alternative paradigm, agricultural sustainability is linked to decreased dependence on external inputs and the development of biological and ecological approaches that utilize and enhance local human and ecological resources. Knowledge and skills developed within the local context are considered to be more appropriate to understanding and integrating ecological, social and economic criteria and thereby to create more balanced and self-reliant agroecosystems (Beus 1995, MacRae et al. 1989).

Zero tillage and organic farming were initially adopted by a small number of Saskatchewan farmers during the late 1960s and early 1970s, in response to problems they identified with conventional agriculture. The impact of conventional agricultural production on the environment was a concern common to both groups of farmers, however the nature of these concerns and their responses to them differed considerably. For some farmers, soil erosion due to excessive tillage was seen as the major environmental problem and they looked for ways to reduce or eliminate tillage. The problem they identified was technical and the solutions sought were technological. To facilitate this process they developed alliances with manufacturers of agrochemical and farm equipment, and with agricultural scientists who also identified tillage and summerfallowing as detrimental to soil quality. These
relationships bore fruit. Technological innovations and a supporting body of agronomic research was developed that were critical to the success of zero tillage on the Prairies. With the formation of these relationships, however, the development of zero tillage changed from being a farmer initiative to being predominantly shaped and driven by public and private sector scientists, and by the economic rationale of input suppliers. Although many zero tillage farmers, public sector scientists and industry representatives whom I spoke with said they believed zero tillage enabled farmers to “take back control” and was being driven by farmers, the organic farmers I interviewed strongly disagreed with this assessment.

The organic farmers viewed the increased dependence on technology and science, and the increased capitalization, specialization, and scale of production associated with the dominant model (and zero tillage) as major factors contributing to the decline of family farms and rural communities. For these farmers an organic approach was a more appealing strategy as it presented an opportunity to regain control over management and labour decisions, enabling them to disengage from a large part of the input sector and eventually from conventional markets as well. Farming organically also required increased reliance upon knowledge gained through on-farm experience and through exchanging and building knowledge with other farmers. By stepping off the technological treadmill they were no longer as dependent on an economies of scale approach. By reducing their cost of production and by selling into premium markets they could remain economically competitive and viable without continual expansion. Organic farmers also maintained that they were significantly reducing the environmental and health risks of farming by eliminating the use of agrochemicals.

6.3.3 Competition Versus Community

Farming is viewed primarily as a business within the dominant model of agricultural development. The emphasis is on increasing the efficiency, flexibility and quantity of production in order to be competitive in global markets. Achieving these goals requires keeping up with the latest technologies, increasing the scale of production and specializing. Many of the structural changes that have occurred in rural Saskatchewan over the past forty years are due to intense competition in primary production. Conventional agriculturalists view changes such as the declining number of farms and rural communities, as necessary adjustments and inevitable outcomes of progressive change.
Within the alternative paradigm the loss of family farms and communities is not seen as a progressive or inevitable trend. Farming is taken to be much more than a business and its purposes include more than commodity production. It is also a way of life that contributes to the creation of community and local knowledge. The revitalization of this way of life and of rural communities is identified as an essential goal for the development of sustainable agricultural systems. Building community more through cooperation than competition is another principle of the alternative agricultural paradigm.

The practice of zero tillage is consistent with the competitive model of production promoted by the dominant paradigm. While most zero tillage farmers expressed a belief that this approach was their best option for adapting to changes in agriculture, most also maintained that farming was more than a business. They expressed a strong commitment to the agarian lifestyle and identified family farms as a fundamental component of sustainable agriculture. The organic farmers also expressed a great deal of pride and satisfaction in being farmers, but were convinced that a low external input approach was the best strategy for maintaining their way of life. Cooperating and networking with other farmers were identified by these farmers as vital to their knowledge building, to securing their labour needs and to their economic viability. A larger number of the organic farms were operated as partnerships, which is indicative of a collaborative, resource-sharing and labour-mobilizing strategy.

6.3.4 Domination Versus Harmony With Nature

For those subscribing to the dominant paradigm, nature consists of resources that are to be managed and controlled for human gain. Nature and human society are seen as separate. Within the alternative paradigm, nature and society are seen as inseparable and therefore the goal is to achieve a balanced and mutually beneficial relationship. In this view, “the body and earth are analogous, and food as co-production is the central unifying material and symbolic linkage that bridges and binds the social and the natural together” (Goodman 1999: 33).

Most of the zero tillage farmers in this study were committed to a productivist and utilitarian orientation. They believed that intensive methods of agricultural production were necessary and were also compatible with environmental sustainability. For these farmers, increased reliance on agrochemicals was
not identified as a risk to the environment or to human health. The chemicals used were perceived to be safe and the application rates low compared to other regions of intensive agriculture. A smaller proportion of the farmers interviewed did, however, express concerns about potential environmental risks associated with zero tillage.

Farming in harmony with nature was identified as a guiding principal by several of the organic farmers interviewed. Organic farming is based on enhancing natural systems through the use of biological and cultural methods. Synthetically manufactured agrochemicals are considered to disrupt natural soil processes and are avoided. Most of the farmers acknowledged that tillage and fallowing can also negatively impact soil processes but they maintained that the frequency and intensity of tillage could be minimized by also incorporating other cultural and biological methods to control weeds and build soil quality.

6.3.5 Specialization Versus Diversity

Production of a limited number of commodities on a large-scale is identified by proponents of the dominant paradigm as the most effective way to produce adequate and affordable food supplies for a rapidly growing world population. Zero tillage is a crop production practice that facilitates increased scale and specialization in crop production. The largest proportion of the zero tillage systems examined in this study were large-scale cropping operations. The development of zero tillage for Prairie conditions has been largely dependent upon advances in agrochemicals, particularly broad-spectrum, non-residual herbicides such as glyphosate, and specialized seeding and spraying equipment. Soil fertility is achieved primarily through the use of synthetic fertilizers.

According to the alternative paradigm, diversity at all levels is the key to sustainability. Ecological diversity is achieved by broadening the genetic base in crops and livestock systems, using diversified and extended crop rotations, and integrating crops and livestock production. Diversity is also to be found in the labour conditions, financial resources, knowledge, skills, values and goals of different farm operators. Heterogeneity in farming practice is therefore necessary and fundamental to balancing the unique combination of ecological and human factors operating within agroecosystems. The organic farming systems in this study were characterized by diversity in crops and livestock as well as by the
wide range of approaches used to improve soil quality and control pests. Diversity within systems is also associated with flexibility; the ability of the system to be able to cope with stresses, withstand changes and retain integrity. One organic farmer commented that becoming organic had increased the diversity and flexibility in his farming system, including flexibility in management decisions. He could remain organic, which he intended to do, or he could go back to being conventional, or convert to zero tillage. There were no major barriers to adopting other farming practices. All the options were open to him. But he maintained that because of the high capital costs of moving into a zero tillage system, and with the system’s dependence on manufactured inputs, once a farmer made the transition to zero tillage it would be difficult to adopt another approach.

6.3.6 Exploitation Versus Restraint

Agricultural development, as envisioned within the dominant paradigm, is the utilization of natural resources for human production and consumption needs. Natural processes and products, including local knowledge and skills, are appropriated or substituted with scientifically and industrially modified products and processes. This industrialized approach to agriculture is also highly dependent on the use of non-renewable fossil fuels. Environmental and social costs associated with this approach are typically ignored in economic analysis, or treated as relatively minor externalities.

Proponents of the alternative paradigm contend that the identification and development of sustainable agricultural practices and policies will require comprehensive evaluation of all social and ecological benefits and costs. They maintain that one of the basic premises of sustainable agriculture should be the restrained use of energy-intensive inputs and more effective use and development of local resources and renewable energy sources. Instead of pushing the ecological limits of production in order to achieve ever increasing production levels, they maintain that attention should be focused on making production and consumption compatible with ecological limits, and providing equitable access to nutritious and adequate food. Finally, local knowledge needs to be valued and enhanced, rather than appropriated and exploited.

Zero tillage is promoted as a practice that preserves and improves soil quality, but also requires investments in new equipment and increased use of energy-intensive inputs. The long-term effects of this
approach on soil and water quality and other aspects of the environment, as well as the implications of widespread adoption on the structure of agriculture and human health have not been extensively researched.

For the organic producers in this study, restrained use of external inputs made sense in terms of lowering the cost of production, lowering the risk to the environment and to human health, and reducing dependence on non-renewable energy sources. Rather than maximizing productivity, the goal was to maximize diversity, improve soil quality through on-farm practices and by recycling nutrients, and thereby to sustain the local resources and the production of high quality products for receptive markets. Many organic farmers felt that further research and extension would be useful to the development and adoption of this approach in Saskatchewan. The importance and validity of farmers’ knowledge, experimentation and control over production and marketing was, however, identified as crucial to maintaining organic agriculture as a truly alternative system.

6.4 Linking Theory and Practice

Smit and Smither (1993) suggest that the way that sustainable agriculture is conceptualized and applied depends largely on the perspectives of different stakeholders whose interests focus on particular dimensions and at certain levels. They identify various meanings of sustainability associated with environmental, economic, production and social dimensions of agriculture at the micro-, regional and macro-level (Table 3.2). The findings reported here support this hypothesis. Most of the farmers in this study, whether organic or zero tillage practitioners, conceptualized sustainable agriculture at the farm-level. There were differences, however, in the sustainability criteria identified by these two groups of farmers. The organic farmers emphasized the following criteria: decreased reliance on external inputs (increased self-sufficiency), improving agronomic resources through the use of ecological and cultural methods, growing crops in harmony with nature, and the preservation of the family farm. Zero tillage farmers also identified the family farm as an important component for agricultural sustainability. The other criteria they emphasized included higher commodity prices to increase farm-level economic viability, improving soil quality, increased yields, balancing economic and environmental goals, and responding to local diversity.
For most of the organic farmers I interviewed, a combination of concerns about the environment, health, economic and social impacts of a high external input approach to agriculture influenced their transition to organic farming. Underlying these concerns, and their decision to change the way they farmed, was their recognition and acceptance of an alternative model for agriculture that provided them with a cohesive theoretical and practical framework. The theory and practice of organic agriculture was therefore identified by many as a way to meet both their material goals (lower cost of production, higher commodity prices, health and environmental quality) and ideological goals (agrarian lifestyle, independence, self-reliance, stewardship). By adopting the organic model, they were able to develop a level of autonomy and control over production, labour and marketing that enabled them to maintain their way of life in accord with their basic ideology, values and goals. By increasing their reliance upon personal knowledge and experience, and sharing and building upon that knowledge with other farmers, they were able to reduce their dependence on the products and knowledge of input suppliers and agricultural institutions. Some of the organic farmers interviewed are politically active in organizations, such as the Saskatchewan Organic Directorate and the National Farmers Union, that lobby for changes in agricultural policy and research. For many farmers, the personal is seen as political, in that the choices they have made in their farming systems and in their personal lives are viewed as ways to influence social change.

The zero tillage farmers I interviewed were motivated to make the transition to zero tillage because of perceived environmental, economic and labour advantages over conventional production. They did not identify any ideological or spiritual factors as having influenced their transition. Most of these farmers, however, expressed a deep commitment to stewardship, the agrarian lifestyle and community. Although commitment to continue practising zero tillage was fairly high among these farmers, a significant fraction expressed concerns about certain aspects of zero tillage, including: the high costs of purchased inputs, the potential health risks associated with increase use of agrochemicals, the potential to increase the size of farming operations beyond what was compatible with stewardship and the maintenance of rural communities, and low commodity prices in conventional markets. Therefore, although the theory and practice of zero tillage is compatible with the conventional/dominant agricultural paradigm, some aspects of this paradigm, such as increased farm consolidation, dependence on agro-
industrial inputs, and emphasis on competition, conflicted with some of the basic beliefs held by some of these farmers.

There was a high level of commitment to organic farming in the population of farmers I sampled. Ikerd (1999) contends that high levels of commitment reflect firm ideological belief. He asserts that many farmers are reluctant to fully recognize or champion the tenets of stewardship and community for fear of being labeled unprogressive, too emotional or lacking business savvy. He contends that many farmers are trapped in the dominant/conventional paradigm even though it conflicts with many of their personal values.

6.5 Summary

Advantages and disadvantages of zero tillage and organic farming identified in this study have been compared and examined in this chapter. Zero tillage management may be more restricted spatially due to its poor performance under high moisture conditions and in poorly drained soils. Zero tillage and organic farmers both reported improvements in soil quality, but there were differences in soil management strategies in the two systems. Zero tillage farmers relied predominantly upon the elimination of tillage and fallowing to improve soil quality, whereas organic farmers used a variety of methods and continued to rely upon tillage and fallowing to varying degrees. While the use of tillage and fallowing may increase the potential for soil erosion in organic systems, the increased use of fertilizers and pesticides in zero tillage systems is associated with a different set of environmental problems, including herbicide resistance and degradation of water quality. Individuals within both these groups of farmers acknowledged these potential problems. Similar to the organic farmers, many zero tillage farmers were using more extended and diversified rotations to aid pest and disease control. Many organic farmers were also using conservation tillage methods and some had replaced fallowing with a leguminous green manure crop. These farmers were, therefore, developing farming systems that integrated some of the beneficial features of zero tillage and organic methods in order to achieve better results.

Diversity in the production system was significantly higher for the organic farms examined. This was identified as important to pest control and soil fertility management, nutrient recycling, and economic stability, and enabled some farmers to reduce the size of their operations. Crop diversity was fairly high
on the zero tillage farms relative to a conventional wheat/fallow system, but the incorporation of livestock into zero tillage systems was limited.

Organic farming systems would appear to provide a greater potential for reduced reliance on fossil fuel-based energy, primarily due to the elimination of manufactured chemicals.

In the current context of low commodity prices and increasing input costs, premium prices for organic commodities and reduced input costs create distinct advantages for organic producers. Labour availability, scale of farming operations and access to capital, may make zero tillage a more attractive option for some farmers. Results from this study and other studies show that although the size of farms under zero tillage management varies, this approach is positively correlated with increased farm size. Organic farming is a more scale neutral approach that is well suited to mixed crop and livestock operations.

With a high degree of land ownership, a reliance on labour exchange with family and neighbours, a smaller average farm size and greater agronomic diversity, organic farming may be expected to contribute more to regional economic stability, community building, and local knowledge of low-input approaches to land stewardship. Due to its association with larger farm size, reliance on agrochemicals for pest control and soil management, a higher proportion of rented land, and greater use of non-family hired labour, the increased adoption of zero tillage in Saskatchewan may be contributing to agricultural and rural restructuring, and decreased attention to the long-term aspects of land stewardship.

The findings reported here support the hypothesis that a strong relationship exists between production practices and worldviews. Zero tillage is more compatible with the dominant agro-industrial paradigm while organic agriculture is closely associated with the precepts of the alternative paradigm. Farmers and farming systems are, however, complex and do not necessarily conform to “ideal types.” Among both the zero tillage and organic farmers sampled there were notable deviations from these two paradigmatic types. For example, although the average size of the organic farms was significantly smaller than the zero tillage farms, it was larger than the average farm in Saskatchewan. The largest farm in this study was an organic farm. Despite the association of zero tillage with large-scale specialized cropping operations, there were some relatively small zero tillage farms and some mixed crop and livestock operations.
Most of the producers, whether zero tillage or organic, expressed a strong commitment to maintaining their agrarian lifestyle, to their communities and to land stewardship. The largest proportion of the farmers focused on farm-level issues of agricultural sustainability. Fewer farmers viewed sustainability beyond the farm-level, extending throughout the agri-food system.

There was some evident conflict between the theory and practice of zero tillage. Many of the zero tillage farmers emphasized the importance of family farms and land stewardship but some also expressed concern that this practice conflicted with these criteria for sustainability because of its potential effects on farm size, land tenure, human health, and the environment. The higher degree of commitment articulated by organic farmers may be attributed to a closer fit between theory and practice. Organic farming did not conflict with farmers' basic beliefs and goals. Rather it was identified as a way for them to farm according to their values and goals. Commitment to organic farming may also be strengthened by challenges to the validity of this alternative practice. As part of a counter-hegemonic movement, organic practitioners are likely to encounter criticism and opposition along the way, which may create some doubts, but are also likely to lead them to closely examine and evaluate the arguments and evidence in support of organic agriculture.
CHAPTER SEVEN: BETWEEN RHETORIC AND REALITY: KNOWLEDGE, POWER AND THE SOCIAL CONSTRUCTION OF SUSTAINABLE AGRICULTURE

7.1 Introduction

Farmers play a central and strategic role in agriculture. From the development of local farming practices and systems to the production of commodities for world markets, the values, perceptions and actions of farmers impact on ecosystems, communities, the national economy, and the global agri-food system. Yet farmers’ attitudes and approaches to sustainability in agriculture have not been well examined. A primary objective of this thesis was to investigate farmers’ perspectives on sustainable agriculture and the ways in which they are putting theory into practice in the field. The three preceding chapters address this objective by examining zero tillage and organic farming systems as well as the ideologies, values and goals shaping farmers’ decisions.

Farming systems are not “bounded enclosures.” They are a “subset of the reactions which constitute social space – a local and unique articulation of the wider whole” (Massey 1995: 115). This social space, formed by the social relations of production, extends beyond the farm to also include networks of actors from a number of different arenas: the state, institutions of agriculture science, local industries and transnational corporations, individual consumers and social movements. As agricultural production is increasingly drawn into the global economy, local and global factors are drawn closer together in a dynamically interacting set of relationships. The objectives, perceptions, priorities and relations of the various parties are constantly influenced and reshaped as a result of the interactions taking place.

In this final chapter, I examine how contemporary social and political forces continue to shape the discourse on sustainable agriculture and how this discourse is being translated and responded to at the local level. This analysis of current trajectories of change illustrates the complexity and dynamic nature of agricultural systems. Agriculture operates at the interface between human and ecological components, but
it is fundamentally a social process shaped by different actors and agencies with a diversity of values, goals, knowledge and experiences. Out of this social process emerge issues of power, control, conflict and resistance. Conclusions drawn from this study are presented in the final section of this chapter.

7.2 Sustainability or Rhetoric: The Dominant Paradigm and the Economic/Environmental Paradox

The industrial model continues to rule within the dominant discourse on the sustainability of agriculture. During the past decade this model has, however, been modified in order to meet economic and environmental criteria that are increasingly being determined within global arenas.

Globalization of the economy, through more liberalized trade, has become a major theme preoccupying dominant economic actors. Agriculture has been identified as one of the main targets of global economic reform by the World Trade Organization (WTO). The goal of the WTO is to create a level playing field for agricultural trade in order to increase the mobility of agricultural products across national borders into the global arena. To accomplish this goal, the countries participating in the WTO have agreed to restrict both the form and the level of government intervention (Sumner 1995). It is claimed that this liberalization of agricultural trade will not only provide consumers with more and better choices, it will also lead to increased efficiency, flexibility, diversity and volume of production, environmental benefits, and perhaps most importantly create new opportunities for the generation and accumulation of capital (Gray et al. 1995).

As a member of the WTO, Canada has been keen to take part in establishing and executing the goals and objectives of the new global economic arrangements. During the same period of time, Canada has also been striving to address international environmental imperatives for the reduction of greenhouse gas emissions established at the 1997 Kyoto Summit. Industrial developments in agriculture and other sectors worldwide have been contributing to changes in global climate that are impacting on the integrity of ecosystems and, hence, threatening their productive potential. Yet, the restructuring taking place throughout the agri-food system, brought about by the new global political economy, is further encouraging specialization and intensification of production (Juillet et al. 1997, McMichael 1995). This trend is expected to result in greater reliance upon industrial inputs in production, increased processing and packaging, and increased transportation of inputs and products – all of which will increase the use of
fossil fuels and hence the emissions of carbon dioxide. The growth in economic activity implied in such restructuring is, therefore, itself a major contributor to ecological instability. The ecological and economic priorities established within the framework of the dominant paradigm appear to be locked in conflict and each can be satisfied only at the expense of the other; more economic growth and environmental degradation, or no economic growth and economic collapse. In addition to these inherent contradictions, the existing economic/environmental debate also continues to externalize or ignore the social issues that are emerging as a result of this model of development.

Over the past decade, the Canadian government has demonstrated a commitment to refashion Prairie agriculture within the context of liberalized trade by progressively eliminating agricultural support policies and programs. The state has also recognized the economic and political importance of addressing certain environmental issues. In order to integrate economic and environmental priorities, a leaner model of specialized intensive production has been designed that can continue to increase productivity as well as manage some of the environmental impacts. “Knowledge-based” technologies such as zero tillage, precision farming, and biotechnology have been identified as the best solutions to achieving these goals. These technologies have served to create a new image of progress and sustainability that is compatible with the dominant model and therefore with the interests of industry and the state. In order to maintain the political, ideological and material conditions of the dominant paradigm, the hegemony has been reproduced and refashioned (Hall 1998). However, the contradictions in this paradigm continue to emerge. The current farm crisis in Saskatchewan is one outcome of these contradictions.

In Saskatchewan, and throughout the world, many primary producers are struggling to survive. For over a century, world agricultural production has grown faster than demand, leading to a long-run decline in international food prices (Mitchell and Inglo 1995). This tendency has been matched by a declining proportion of the world’s population deriving its livelihood from agriculture and by an increase in the absolute number of rural households living in poverty (Binswanger and Deininger 1995). Although there are distinct historical and contemporary factors shaping the situation in different settings, similar themes can be found everywhere: low commodity prices as a result of increased production of commodities worldwide, increasing cost of production, loss of local autonomy over production and labour decisions, increasing consolidation to compensate for declining margins. All these factors constitute a
formula for rural decline. Yet the impacts of agricultural restructuring on Saskatchewan farmers and rural communities were largely ignored until the recent crisis emerged. A policy analyst with the Saskatchewan Department of Agriculture and Food explained to me in 1994 why this occurred.

In Saskatchewan, the social aspects of sustainability haven’t been emphasized in policy analysis or planning. Our main concern has been to balance economic, primarily trade, and environmental issues. The impacts of restructuring on rural communities have not been a major consideration. It’s a problem with our approach, but then again, has there ever been a vision for rural Saskatchewan? Change has more or less always been forced upon rural communities as a result of political and economic trends. The government’s current position is one of less interference - that things will be sorted out for the best in the marketplace.

In addition to the social and economic costs, an industrial approach to agriculture also places pressures upon soils, water and the functioning of the ecosystem as a whole. In Saskatchewan, the state has been primarily concerned with reducing soil erosion through the reduction and elimination of tillage and fallowing. Little attention has been paid, however, to the energy costs associated with this approach or to the long-term effects of increased reliance on fertilizers and pesticides on the environment and on human health.

7.3 Spaces and Places for Resistance

Media reports on the recent meeting of the WTO in Seattle, Washington captured vivid images of the confrontations taking place between dominant political/economic forces and individuals and organizations within civil society expressing resistance to the changes being imposed by those forces. There were approximately 50,000 people from many nations, cultures and social sectors that gathered to represent the widespread and coalescing grassroots resistance to the process of globalization as defined by the WTO. The impacts of a globalized economy on the environment and on labour were the focal points around which resistance was mounted. But many people see the effects of globalization extending beyond the material conditions of everyday life (e.g., labour, production processes and products, the state of the environment) to the ideologies and values shaping personal identities, community, culture and democracy (Shiva 1999).

According to Gramsci (1971), the problems or contradictions that emerge from hegemonic/dominant models provide theoretical spaces and political places for resistance to occur. Within these spaces and places, critical interpretation of these contradictions begins to emerge, leading to
recognition that hegemonic rule is oppressive and damaging to the interests and values of individual actors and ultimately to the integral functioning of the system as a whole. The ideology and approaches of hegemonic rule are, therefore, critically examined. Counter-hegemonic ideologies, approaches, and organizations are created, offering possibilities for resistance and change to occur.

During the past decade, a number of events and developments have taken place within the food system that have triggered reactions among consumers, worldwide, regarding the safety of the food they eat (e.g., the outbreak of bovine spongiform encephalopathy (BSE) or mad cow disease, and Creutzfeldt-Jakob Disease in humans eating BSE-infected meat products in England; the irradiation of food as a means of preservation; salmonella-infected foods; and the use of genetic engineering in food). As a result of these and other developments, there is a growing distrust within the general public of the authoritative roles of science, industry and the state in defining, evaluating and regulating food safety. Consumers are becoming more discerning about how food is produced and processed, and are making personal choices in the food they purchase that are having social and political ramifications. The power of consumer choice affects the production and marketing of all products, but food is fundamentally different from other consumer products. It is not only something that is necessary on a daily basis for human life, it is also bound up in culture and traditions. Food is something that we care about immensely. Decisions about food are giving rise to political commitments. The current debate over the genetic engineering of food illustrates just how political food has become.

Genetically engineered food products entered the global food system in the early 1990s. By the end of the decade, "more than 40 genetic modifications related to 13 different crops were approved and produced in one of 12 countries and to varying degrees were available to other countries through international trade" (Phillips and Foster 2000:1). Public awareness and concern about these genetically modified (GM) products began to reach a critical point in 1998, when individuals within the scientific community began providing evidence of health and environmental risks associated with GMOs, which fueled questions as to the safety and the politics of biotechnology research and regulation. During an interview on BBC television in 1998, Dr. Arpad Pusztai, of the Rowett Research Institute in Scotland, reported that experiments conducted in his laboratory indicated that GM potatoes had negatively affected
parts of the gastrointestinal tract of rats.¹ In Canada in 1998, the Senate Standing Committee on Agriculture and Forestry began hearings to investigate the safety of recombinant Bovine Somatotrophin hormone (rBST) in dairy cattle. Several scientists working for Health Canada, the federal food regulatory agency, testified that studies they conducted at Health Canada laboratories indicated that the introduction of this hormone into dairy cattle for increased milk production posed a risk to both human and animal health. Furthermore, these scientists alleged that Monsanto, the company producing and marketing rBST, and senior bureaucrats within Health Canada concealed these results and attempted to prevent the scientists from making this information publicly known, in order to attain regulatory approval of the use of rBST in Canada. Based upon an independent review of the scientific results, rBST has been banned in the Canadian dairy industry.

Scientific evidence of the risks involved in the use of genetically modified organisms (GMOs) in agriculture has been limited to date, but resistance to the production and distribution of genetically engineered agricultural products has been growing rapidly during the past few years. The result has been the formation of a global broad-based coalition of individuals and organizations, experts and ordinary citizens. In addition to concerns about a number of different environmental and health risks, concerns have also been raised about the commoditization of the genetic resource base and increasing control by a small number of powerful agribusiness firms over the food system (Kneen 1999). Resistance to GMOs has been the strongest in England and throughout other parts of the EU, which some attribute to the experience of mad cow disease (Carr 1999). Goodman (1999) adds that this resistance may also be due to the important role food plays in European culture. Resistance is also gathering throughout other parts of the world, including North America, where most of the genetically modified corn, soya bean and canola are grown. In Saskatchewan, over 50 percent of the canola grown in 1999 was GM canola. In a recent review, Phillips and Foster (2000) found that due to growing concerns about GMO’s in the food system, 16 countries plus those within the EU have signaled intentions to adopt labeling of GM foods. Most of these countries have made a commitment to mandatory labeling, whereas Canada, Argentina, the United

¹ Phillips and Foster (2000: 3) summarize the academic and public reaction to Pusztai’s findings: “When the authors subsequently submitted it for peer review, they chose to withdraw some of their conclusions and the key scientific societies in the UK and elsewhere have challenged both the methodology and results of the study. Nevertheless, the public largely believes that GM products are unsafe.”
States and Russia have indicated plans to introduce voluntary labeling. This survey also identified 21 retailers and six restaurant chains around the world that are publicly advertising they will not carry or use GM products. When McCain’s Foods, Canada’s largest potato processor, announced their decision not to accept any GM potatoes from producers and suppliers, they emphasized that this was purely a business decision based on growing consumer demand, and there was no scientific evidence of a food safety risk (Western Producer, December 23 1999 pp 43). The Canadian Wheat Board (CWB) also took a similar position regarding genetically altered grains. Due to the impact of increasing resistance to GMO on export markets, the CWB announced their decision to segregate and label GM grains was based upon their philosophy that the “the customer is always right.”

Growing distrust of the conventional food system is generating increased interest in local and organically grown food; food that can be traced back to particular origin and a method of production that prohibits the use of industrial inputs, such as agrochemicals, GM seed and other products. Within the conventional system, food production and processing has been increasingly distanced from consumers. The organic certification process was developed partly in response to consumer demands for a regulated system that they could trust to provide them with food that was grown without the use of synthesized agrochemicals and processed without additional additives, thereby reducing the potential for health risks for them and their families. By purchasing food according to the conditions under which it is grown and processed, consumers are taking a more active role in shaping food production. For some, buying organic is also linked to their support for the continuation of family farms and rural communities. Organic agriculture is viewed as a form of resistance for farmers, enabling them to reduce their dependence on external inputs and disengage from conventional markets. Thus, there is a small but expanding segment of producer and consumer sectors that are choosing alternatives to the conventional food systems, based upon both material and ideological concerns.

7.3.1 Challenges to the Formal Knowledge System

The development of modern agriculture represents a technological, demographic and cultural revolution, brought about by scientific innovations and the application of the industrial model of production. Over the past few decades there has been growing concern about the global effects of this
approach to agriculture on natural resources, environmental quality, human and animal health and rural communities. These concerns have resulted in critical re-examination of the theoretical and methodological perspectives that have shaped the industrial model.

Since the postwar period there has been an increasing emphasis on productivist and utilitarian goals and the professionalization of knowledge in agricultural institutions in Saskatchewan. Criticism of this narrow and hierarchial approach have been raised in studies and reviews that have taken place in the Province over the past forty years. During the 1950s, the Saskatchewan Royal Commission on Agriculture and Rural Life examined the rapid changes taking place throughout agriculture and the impacts these changes were having on rural communities. One of the main concerns raised by rural participants was that agricultural institutions were failing to provide the range of support they needed in addressing the changes taking place in agriculture. As a result of the emphasis on agricultural productivity within these institutions, other issues affecting farmers and rural communities were being neglected. In order for the institutions to become more responsive to the interests and needs of rural citizens, the Commission recommended that rural constituencies have opportunities to play an active role in determining research and extension priorities. More recent reviews at the University of Saskatchewan, such as the Task Force on Rural Development (1985) and the Issues and Options Report on Extension (1990), also call for a broader perspective in agricultural research and extension, and an increased role for rural communities in identifying and developing solutions to the challenges they face.

Farmers continue to express frustration over the distancing of public institutions from the constituencies they were established to serve. Farmers are facing a host of new issues from environmental degradation and child care concerns to biotechnology. Yet instead of finding leadership from the agricultural scientists and economists, farm leaders gathered at a Canadian Federation of Agriculture (CFA) meeting in 1997, said “the experts appeared to be out of the loop, focusing instead on trade goals while underlying problems of farm income and food safety go largely ignored” (Western Producer July 31, 1997: 6). Jack Wilkinson, farmer and CFA president commented:

These bureaucrats and experts seem isolated or uninterested in farmers’ pleas. We feel like we are out there on our own, trying to cope. If we are looking for leadership from the Department of Agriculture, forget it. They are insensitive to the issues facing farmers and aren’t apologetic about their arrogance.
Padel and Lampkin (1994) challenge the prevailing emphasis on productivity in order to be competitive in global markets. Due to overproduction of a limited number of commodities worldwide, real output prices have steadily declined while real inputs costs have elevated – the classic cost-price squeeze. The residual element, farm income, has declined as a consequence. In order to compensate for this trend, farmers have been encouraged to specialize, keep up with the latest technologies, and increase the size of their farming operation.

It has long been a criticism that innovations developed and promoted within the institutions have primarily benefited agribusiness firms and farmers with similar philosophies and access to adequate capital resources (e.g., Hightower 1973, Busch and Lacy 1983, Lockeretz and Anderson 1993, Kloppenburg 1991, 1992). According to Lockeretz and Anderson (1993), larger, technological and specialized farms have been the major beneficiaries of this research with little attention is given to smaller, diversified farms using low-input approaches. These and other critics argue that there has been a monopolization of public resources for approaches that are compatible with the interests of industrial capitalism. Therefore, despite claims of objectivity and neutrality in science, there are political implications in the choices made in agricultural research, from the choice of research problem to the method, to the analysis and the application.

Triggered in part by fiscal constraints and also by the increasing emphasis on new high-tech approaches in agriculture, research programs have been undergoing a radical transformation during the past ten years. The number of permanent positions has declined, while short-term contract positions (generally two-three years in length) focused on narrowly defined projects with specific goals have been increasing. Many of these projects are co-partnered with industry, as scientists are being forced to seek opportunities for collaboration and funding in the private sector. All these factors are influencing a shift from basic long-term public research to more applied, short-term research, compatible with profit-making motives. Michael Martin, Dean of the University of Minnesota's College of Agriculture, warned of the dangers of the increasing alliances between the public and private sectors.

Our college has a long history of soliciting money from the private agribusiness with the promise of matching public dollars. It started off being a system of public dollars attracting private dollars, in pursuit of the public interest. The balance has shifted. Increasingly it is private dollars attracting public funds in pursuit of private interests... You get a lot of problem solving but not necessarily a lot of knowledge discovery. It turns very good scientists into very bad accountants.
who have to spend increasing amounts of time soliciting funds. This has changed the balance of what we do and I'm not sure that change is in the best interests of the people we are supposed to be serving. Government bureaucrats are demanding more accountability for public research spending. But the emphasis is on profit-making results, without taking into account the broader forces at play. I fear we are being held more accountable for less meaningful outcomes (Michael Martin, Western Producer Jan 9, 1997: 10).

Most of the agriculture scientists interviewed in this study shared this view. They expressed concern that the strengthening of the relationship between public institutions and the private sector is making it more difficult to separate public research done for the common good and applied research beneficial to industry's goals. The following comment was made by an Agriculture Canada scientist in 1995:

There's a definite risk associated with increased involvement of industry in public research and extension. We may go too far and lose sight of our real goals.

Agricultural research and extension practitioners that ignore whose interests they serve have been criticized on the grounds of ethical irresponsibility (Clark et al. 1996, MacRae et al. 1989). As a result of the social contract between agriculturalists and the public, there is a responsibility to ensure that the interests being served are not their own or those of a privileged sector of society. Moreover, there is a responsibility to safeguard against damage to the interests of other parties. This responsibility is morally if not legally enforceable. MacRae et al. (1989) point to legal action taken against researchers in reaction to negative impact of agricultural research.

The case can be made that scientists simply fail to perceive or understand the social impacts of their work as they are often far removed from the end use of their research. For the most part, scientists and institutions of agricultural research and education are preoccupied with securing adequate funding to maintain institutional structures and their scholarly status, which requires meeting the approval of disciplinary organizations. Personal career advancement is heavily weighed by the amount of research published in recognized scientific journals and by the amount of funding one acquires for research. In 1996, a scientist from the University of Saskatchewan College of Agriculture commented on the situation scientists face:

Careerism in the scientific world is associated with a narrow field of view and extensive publication within your area of speciality. That's definitely what will get you the furthest in terms of promotions and merit increases, and it is also what is generally considered to be academically successful within the culture of one's peers. Looking beyond the disciplinary focus, in research or teaching, is looked upon as straying, going off track, losing focus. As research funding is increasingly tied to the private sector, there has been an increased emphasis on technological solutions and the lack of attention to alternative low-input approaches. As this
relationship with industry strengthens, it seems as though we are increasingly loosing connection from farmers and rural communities.

The scientific method reduces complex systems or phenomena to a relatively small number of quantitatively measurable variables that can be observed and tested in replicated trials. The data are used to statistically validate or disprove a hypothesis and if validated the information is used to formulate a theory or universal law. MacRae et al. (1989) acknowledge that a reductionist and mechanistic approach to the study of complex systems is intellectually tempting as it is easier to study and manipulate the parts. But in the case of complex systems, such as in agriculture, they argue that the whole is greater than the sum of its parts, and with a reductionist approach the relationship between the parts are often undetected. Complex systems cannot, therefore, be analyzed by examining a few variables, formulating general laws and then applying the laws back to the system.

As a result of the emphasis on quantifiable and replicable data, qualitative data are generally considered inferior and left out of the analysis. This approach has generated a narrow perspective of agricultural systems, limited to economic and biophysical variables and a focus on technical solutions. Flora (1992) argues that this approach promotes a simplistic view of production and distribution.

When we work with complex systems, such as agriculture, we know there is never a single solution to a problem and that each solution brings with it a new set of problems (Flora 1992:93).

This conventional approach to the study of agriculture fails to recognize the social dimensions of agricultural systems and the broader range of economic and ecological issues that emerge. Flora comments that this narrow focus impacts on how sustainable agriculture is conceptualized within these institutions:

There is the general assumption within agricultural institutions that solving environmental problems in agriculture will produce sustainable agricultural systems. But if the main concern is about soil erosion, there is no reason to doubt that large farms run by efficient farm managers hired by transnational corporations could be sustainable (Flora 1992: 95).

Chambers (1988) has commented that the sustainability of the resource base makes little sense if it is separated from the human agents who depend upon it for a material living and as a location for personal identity and community. MacRae et al. (1989) contend that the dominant approaches to the study of agriculture in institutions of agriculture science are not sufficiently comprehensive and that agricultural
scientists interact with too few players in the food system to establish a sufficient knowledge base for truly sustainable agricultural systems.

Several problems with the dominant model have also severely limited the effectiveness of extension (Buttel 1992, Flora 1992, Ruttan 1996). First, the information flow is predominantly top-down, with no formal channels for farmers' concerns, needs or innovations to reach the research sector. Second, there has been an uncritical acceptance and a promotional stand towards technological change, with inadequate attention paid to socio-economic and ecological impacts. A scientist with Agriculture Canada commented in 1995:

There has been a promotion of capital intensive approaches beyond what was feasible economically, and even agronomically.

Farmers are often blamed for failing to adopt a new technology, rather than questioning the appropriateness of the innovation or investigating the social and political processes involved in knowledge generation and utilization.

7.4 Battlefields of Knowledge

It is on these battlefields of knowledge, through a dynamic process of contestation and assimilation, that innovation and knowledge creation operate (Long and Long 1992).

The two competing paradigms in agriculture are giving rise to powerful social and political forces that are shaping the discourse on sustainability, working either to advance the status quo or to bring about social change. Powerful alliances have formed between industrial capitalism and the state to promote the sustainability of a modified industrial approach to agriculture. Resistance to this paradigm and the creation of an alternative vision for agriculture is being formed within a new social movement. This movement is broadening the discourse on agricultural sustainability beyond the economic and technical focus of the dominant paradigm, to include issues such as food safety, the impact of agrochemicals on environmental and human health, biodiversity, the role of family farms and rural communities, and the authoritative positions of science, industry and the state. According to Eyerman and Jamieson (1991), social movements are more than simple challenges to power. They are also creative engines that produce new knowledge and new organizational forms and principles. They involve fundamental shifts in the consciousness of the participants.
In response to the resistance that is emerging to the products and processes of the industrial approach to agriculture, experts from both the public and private sector have begun making public statements, emphasizing the viability, safety and sustainability of the changes taking place in agriculture. In some cases, this is also accompanied by attempts to discredit or trivialize public concerns and counter any potential forms of resistance. One such case is the development of national organic standards in the United States (Buck et al. 1997, Goodman 1999). In 1994 a draft of the standards, developed by representatives from the organic industry (the National Organics Standards Board (NOSB), was presented to the United States Secretary of Agriculture. In 1997, the United States Department of Agriculture (USDA) drafted a new National Organic Rule which largely ignored the well-established and widely accepted international standards of organic practice, and the philosophical and socioeconomic dimensions of the organic movement which had formed the basis of the NOSB recommendations. In their definition of organic, the USDA proposal accepted the use of irradiation, the agricultural application of municipal sewage, and genetically modified organisms. Goodman (1999: 31) describes it as “a calculated move (by the USDA) to destabilize the organic agro-food network.” Following the release of the USDA proposal to the public, there was a storm of protest from the organic industry and supporters. After receiving 280,000 communications, the Secretary of Agriculture announced that the appropriate changes would be made following further input from the organic industry.

In addition to these types of strategies to dispel public reactions and forms of resistance, industry and the state have also begun to respond to consumer choices. As was discussed in Chapter Three, the corporate sector is vertically integrating into the organic and natural food system, particularly in processing and marketing. In addition to the examples previously provided, Gerber and Heinz, two of the largest manufacturers of baby food in the world, have recently announced they will be producing new lines of certified organic baby foods that are also guaranteed to be GMO-free.

7.4.1 Recent Developments in the Saskatchewan Organic Industry

Over nearly a thirty-year period, from the late 1960s to the mid-1990s, the adoption of organic farming progressed slowly in Saskatchewan. Surveys taken in 1996 and 1997 indicated there were approximately 360 to 400 organic farmers with 240,000 acres certified in the Province. Green (1990) and
Smith (1994) identified lack of relevant information and support as major factors limiting the transition to organic farming. Despite this lack of local support for organic agriculture, during this period of time global demand for organic products expanded beyond supply.

Scientists, extension agents and policy analysts interviewed in this study were asked why organic agriculture had received relatively little attention within public agricultural institutions in the Province, given the growing consumer demand. Most said that organic farmers represented a very small proportion of the total number of farmers in the Province, therefore, their needs and concerns were a low priority. In addition, organic farming, unlike other agricultural sectors, had no corporate sponsorship and no commodity check-off system to generate the financial resources to attract matching public funding. One senior policy analyst commented in 1994 that "the government could not openly support organic agriculture, as it is seen as a threat and a challenge to big business, and the agricultural institutions are very tied to big business now, financially and politically." He believed, however, that consumer demands and increasing awareness of the environmental impact of agrochemical use would eventually increase interest in lower-input and more ecologically based approaches such as organic agriculture.

During the past few years, interest in organic agriculture has increased within both the public and corporate sectors in Saskatchewan. This has increased accessibility to information and support for organic agriculture, which has served to elevate the profile of organic agriculture in the Province. The current debate over genetically modified foods is also drawing attention to organic agriculture as an established and regulated source of GM-free products. Consumer demand for organic foods is increasing as a result of widespread concerns about environmental, social and health and safety issues surrounding the use of genetic engineering in the food system. All of these factors have had an influence on the adoption of organic farming in Saskatchewan, but many farmers maintain that the most important factors influencing recent transitions to organic agriculture have been economic.

In 1999, several organic farmers and marketers in the Province informed me that the number of organic farmers in Saskatchewan was rapidly increasing. In February 2000, I telephoned contacts for each of the certification bodies operating in the Province (eight OCIA chapters, Pro-Cert, SOCA, and COCC) to verify this information. During the 1999 crop year, there were 832 producer members in these organic organizations, with 589 fully certified members and 243 members in transition. Most of the
agencies commented that they expected their membership to double this year, based on the inquiries they were receiving. Most of the people I spoke with believed that this rapid increase in the organic farming sector is primarily due to the current economic advantages of organic farming. With lower input costs and premium prices, organic agriculture is being viewed by an increasing number of Saskatchewan farmers as a viable economic strategy. Some members of the organic community are concerned about the degree of commitment that these new entrants have to the philosophy and practice of organic farming. One of the more experienced organic farmers that I interviewed said that, although economic considerations have been important to many of these farmers, the economic advantages of organic farming were also important for him and every other experienced organic farmers he knows. Having spoken with many of the new members undergoing certification in his OCIA chapter, he maintains that the fundamental reason these farmers are converting is that “they not longer want to buy into the conventional model of agriculture” and have come to see that organic agriculture is a way to disengage from this model. He also added that in many of these farm families, it was the women who were initially attracted to organic agriculture due to their concerns about the health and environmental risks associated with the use of agrochemicals. These women then influenced their husbands to make the transition to organic agriculture.

From the 1970s to the mid-1990s, organic farming systems received little attention from the research community in Saskatchewan. In recent years, other provincial and federal institutions have begun to investigate various aspects of organic agriculture. Organic farming systems were included in two major Agriculture Canada research projects, funded by the Greenplan, which compared the sustainability of conventional and alternative farming systems (Gameda et al. 1998, Brandt et al. 1997). Agriculture Canada is also carrying out production research pertaining to organic systems. Organic farming systems have been included in this study and other research projects that were part of the University of Saskatchewan and University of Regina PECOS study (Abaidoo 1997, Kristjanson 1997). These examples indicate changes are taking place within these institutions with regard to organic agriculture. Informal conversations and interviews conducted during this study indicated, however, that most individuals within these institutions remain sceptical about the viability of organic farming. Only a few individuals spoke favourably about this approach and about those who chose to farm this way. A researcher with
Agriculture Canada, who has worked directly with organic farmers on some research projects, made the following comment:

I’ve been very impressed with the organic producers I have worked with over the past two years. They are really sharp, probably the sharpest producers I have ever worked with. They have no problem understanding our technical reports and they immediately identify the weak spots in the research methods and in the data, and suggest ways to improve our approach. There is a real collaboration taking place. I’m really impressed with their knowledge and skill level.

Most of the organic farmers I spoke with were pleased that attitudes towards organic agriculture were changing within these institutions. One farmer had this to say:

It’s been great watching some of the scientists gradually become aware that there is more to organic farming than they originally believed. It’s like a light goes on for them when they begin to look at this approach in a new and more holistic way. It’s great because they become eager to share this awareness and their results with us. But it has been a long time coming and there are still only a handful of researchers and extension agents that are expressing a sincere interest in organic systems. Many still believe that we are incompetent farmers, zealots, even though they know virtually nothing about organic systems or about organic farmers. They have no idea that there are some extremely capable and successful producers and business people in the organic community.

Over the past few years, other government agencies have also been showing an increased interest in Saskatchewan’s organic sector. In 1998 the Saskatchewan Department of Agriculture and Food assigned a half-time agronomist position to assist organic farmers to improve and expand production. During the past two years, the Saskatchewan Institute of Science and Technology (SIAST) and AIMS have co-funded the development and delivery of seminars on the basics of organic agriculture to interested farmers in rural centers. Federal and provincial funding has been obtained to develop a manual on organic production for the Canadian Prairie, to be published early in the year 2000 (Gary Smith, personal communication 1999). Government funding also assisted the development of the Exploring Organic Alternatives conferences (1998, 1999), where current issues in organic agriculture were examined by speakers from Europe, Australia, the United States and Canada. These activities convey a clear message that the government’s interest in organic industry development has increased. While some organic farmers are pleased that government interest and support has been increasing, some feel it is still modest in comparison to that received by other agricultural sectors. Others are opposed to government involvement in the industry as they feel it will take control away from the farmers. All of the organic farmers I spoke with believe that this recent interest from government agencies is due to the growing market potential of organic agriculture, but that these institutions still deny or fail to comprehend the real
potential that organic agriculture offers to the sustainability of agricultural ecosystems, family farms and rural communities.

There has also been interest in organic products by the conventional retail and marketing sector in Saskatchewan. In 1999, the Saskatoon Cooperative Association of Retail Food Stores announced it would begin offering a wide selection of organic food to their customers (Saskatoon Star Phoenix, October 9, 1999). Agribusiness firms have also become involved in marketing and processing organic grains in Saskatchewan. The Saskatchewan Wheat Pool announced it was “going green” in an advertisement in the Western Producer in 1997 (Figure 6.1). The company now has three organic elevators in operation and is also opening an organic flour mill in the Province. In August 1999, The N.M. Paterson and Sons Company launched a joint venture with Neil Strayer, Western Canada’s largest independent marketer, to form Growers International Organic Sales Inc. for the merchandizing of organic grains (Western Producer September 23, 1999: 62). The Canadian Wheat Board has expressed an interest in facilitating the marketing of organic commodities and featured organic production and marketing at their annual conference, held in Saskatchewan in November 1999.

The growth and expansion of the organic sector in Saskatchewan and elsewhere can be partly attributed to the growing demands of consumers and the concomitant adoption of corporate “greening” strategies by companies attempting to appeal to these consumers. Rosset and Altieri (1997), Buck et al. (1997) and Lyons (1999) contend that these changes indicate that agribusiness is finding ways to appropriate and reshape organic agriculture to its own advantage.

Marketing and distribution is increasingly following conventional patterns, both geographically and institutionally, more so than production. Here, capital does not face the same land-based obstacles as with production, and moreover can take advantage of certain economies of scale (Buck et al. 1997: 15).

Buck et al. add that although organic agriculture may be “providing fertile ground for its own capitalization”, it also impedes appropriation by the corporate sector in the following ways:

1. the diversity of organic production systems and the elimination of synthetic agrochemicals requires a more artisan-like approach to farming;
2. diversity in production enables the development of economies of scope;
3. in addition to organic agriculture being part of the agri-food system, it is also part of a counter hegemonic movement that has raised a wide range of social, economic and ecological objectives, including support for family farms and rural communities.
ATTENTION
ORGANIC PRODUCERS

Saskatchewan Wheat Pool is going green.

Naturally.

Now producers of organically grown crops can deliver to Canada's largest grain handler and receive cash payment on delivery.

Saskatchewan Wheat Pool is opening the organic market, giving producers access to reliable service and immediate payment, including organic premiums.

With local, accredited facilities, Saskatchewan Wheat Pool is bringing more options to producers of certified organic crops. It's part of our plan to shape the next century of agri-business.

For more information, contact the Saskatchewan Wheat Pool representative in your area.

Our mission is to be the most dynamic agri-business co-operative in the world.

POOL
THE NEXT CENTURY

(Western Producer May 8, 1997: 9)

FIGURE 6.1 SASKATCHEWAN WHEAT POOL IS GOING GREEN

The rapid changes taking place in the Saskatchewan organic industry during the past few years are highlighting differences of opinion that exist within the community. Some organic farmers believe that corporate involvement in marketing and processing has expanded opportunities and brought greater economic stability for farmers. Other organic farmers are opposed to involvement of the corporate sector for both philosophical and economic reasons. They contend that organic commodity prices have dropped as a result of corporate involvement and that farmers are losing control over industry developments. For organic agriculture to remain a truly alternative approach, they argue that farmers need to maintain control over production, marketing and processing, either through individual or cooperative action. Government involvement is also identified by some farmers as a threat to the integrity of the organic
industry, whereas others welcome the research opportunities and assistance in organizational activities that are taking place. Growing consumer demand suggests that the organic industry in Saskatchewan and elsewhere will continue to expand and progressively move from the margins towards a more mainstream position. With the involvement of a new array of actors participating in organic agriculture, new relationships are formed and changes will continue to take place. As this occurs, debate over the direction of change is likely to continue within the organic community here and elsewhere.

7.4.2 Recent Developments in Zero Tillage in Saskatchewan

Since the 1930s, soil erosion has been identified as the major environmental issue in Prairie agriculture. In recent years the focus on soil conservation has been augmented by international concerns about global climate change. Over the past two years, Canada has been searching for ways to meet the objectives outlined in the Kyoto Protocol to reduce the production of greenhouse gases. As part of these efforts, considerable attention has been directed at investigating agricultural practices that maximize the potential of soils to act as carbon sinks. This sequestered carbon would, therefore, be factored in when calculating carbon emission levels. Ralph Goodale, federal minister of natural resources, explains why Canada has taken a lead role in advancing the carbon sink theory.

The Canadian position is clear. We see the carbon storing capacity of the soil as a tremendous opportunity for farmers around the world to be part of the climate change solution. Discussions are underway as to whether there will be a crediting system established for those farmers and industries that take a lead in contributing to the reduction of greenhouse gases (Ralph Goodale, as quoted in the Western Producer. March 11, 1999: 31).

As a result of this interest in the carbon sink strategy, both the public and private sectors have re-focused their attention on the role that zero tillage can play in carbon sequestration and in a carbon crediting system. Conventional knowledge indicates an initial surge in carbon stored as soil organic matter in zero tillage systems and after time a plateau is reached and eventually sequestration ceases as output balances inputs (D. Anderson, personal communication 2000). As was discussed earlier (Chapter Three, section 3.3.1.3), it was this aspect of zero tillage that influenced Transalta Utilities to commit significant financial support for the Saskatchewan Soil Conservation Association from 1994 to early 2000. An SSCA employee commented in 1999 that continued support by Transalta for the SSCA is uncertain, as the
company is indicating it may target their financial support directly at farmers who are practicing zero tillage (confidential communication, 1999).

The development of zero tillage in Saskatchewan has already benefited from the attention that has been given to its carbon sequestering potential. But the actual potential for soils to sequester verified quantities of carbon and the potential contribution of zero tillage have yet to be validated. There are a number of variables that make research in the area complicated including diversity of soil types, climate, crops and identifying an appropriate time frame for analysis (G. Padbury, personal communication 1999). There are additional complicating factors associated with zero tillage systems that also need to be considered, including the amount of carbon dioxide produced during the manufacturing of synthetic fertilizers and pesticides used in zero tillage systems, and the production of nitrous oxide in zero tillage systems (Janzen et al. 1998). Despite the fact that investigations have not yet been able to quantify the soil’s potential to store carbon under various agricultural practices, and the difficulties of measuring the amount of carbon actually stored, the government and industries appear eager to establish a carbon credit system. If this is put into place, farmers in Saskatchewan may have an additional economic incentive to make the transition to zero tillage. Other production practices (e.g., forage crops in rotation, minimizing fossil fuel-based inputs, and eliminating summerfallow) have the potential to sequester carbon and farmers incorporating these practices would also benefit under a carbon credit system. The current farm crisis may, however, counteract the positive effects of a carbon credit system on the adoption of zero tillage.

The magnitude of the current farm crisis in Saskatchewan has been compared to the crisis of the 1930s by agricultural economists (e.g., Rosaasen 2000). The Canadian Wheat Board has projected that low commodity prices will continue for at least the next five years. As a result of this grim economic situation, many farmers are looking for strategies to save their farming operations. Capital intensive approaches such as zero tillage may not be a viable option for many of these farmers. Although findings from this study and other studies indicate a positive correlation between the adoption of zero tillage and farm size and income, in Saskatchewan there are also smaller-scale farms employing zero tillage. One-third of the farmers practicing zero tillage in this study said that they were only conditionally committed to the practice, due to economic considerations and their concerns about the environmental and health
risks associated with increased use of agrochemicals. In 1994, an extension specialist with Saskatchewan Agriculture and Food commented that extension agrologists throughout the Province were reporting that many farmers were telling them they could not afford zero tillage.

They are telling our agents that “we’ve had enough of zero till. Tell us something new, something we can afford to do.”

The economic situation for most farmers in the Province has worsened during the past few years, which suggests that the current farm crisis could negatively impact on the adoption of zero tillage in the Province.

Along with the trends to continuous cropping and reduced tillage management, the use of agrochemicals has increased significantly in Saskatchewan during the past two decades. Farmers and scientists are expressing concerns that this trend is not sustainable and are calling for changes in zero tillage management. To combat the increasing occurrence of herbicide resistance, Agriculture Canada and the SSSA have been encouraging farmers to diversify their rotations and rotate their use of herbicides (e.g., Saskatoon Star Phoenix, February 21: 1). But according to a weed specialist, formerly of the College of Agriculture, acquired resistance in weeds will continue to increase as long as herbicides are used.

There are very few really new herbicides with new modes of action. The attitude that the industry is going to come up with a new solution is wrong. It just won’t happen. Weeds can adapt and change faster than we can development new herbicides. Mixing herbicides only delays resistance. It doesn’t prevent it. The number one way to overcome the problem is to use less herbicides (Devine 1996).

Derksen et al. (1996) have also argued that reduced use of agrochemicals in reduced tillage systems is necessary and that low-input farming and conservation tillage practices may be mutually supportive. A soil scientist from the College of Agriculture shared this view and provided some additional comments in 1995:

The major problem with zero tillage, as I see it, is the increased use of pesticides and fertilizers. We just don’t know enough yet about the long-term impacts of chemical use on the environment or human health. We need to redesign the system from the bottom up, develop a low-input zero tillage system that is more ecologically based. Right now, zero tillage is being driven by the interest of agribusiness. Nature is the last place that agribusiness looks for answers. They take nature out of the picture. From their point of view, it is too complex, creates too many variables.
Farmers have also expressed their concerns:

Zero tillage can’t be sustained if farmers simply replace tillage with herbicides. When we take out tillage we’ve got to replace it with rotation, sanitation and competition, not technology (Dwayne Beck, zero tillage farmer from South Dakota. Manitoba Co-operator, February 19, 1998: 12).

We’ve got to do things that work more in harmony with nature. As it is being practised, no-till is not totally sustainable (Bob McNabb, zero tillage pioneer from Minnedosa, Manitoba. Manitoba Co-operator, February 19, 1998: 12).

One zero tillage farmer in this study commented:

We’ve come through the chemical age. Now we’re going to have to look at the whole system.

In order to decrease the reliance on pesticides some producers in Manitoba have recently formed a Pesticide-Free Crop Production Association. In January 2000, this producer group and researchers from the University of Manitoba, Agriculture Canada and Manitoba Agriculture received provincial funding to develop agronomic and market research for this reduced input approach (Western Producer January 20, 2000: 1). Lowering chemical use is viewed by this team as a way “to combat herbicide resistance” and reduce input costs for farmers. It is also anticipated that this approach will also generate new markets by appealing to consumer concerns about pesticide residues in food. Dr. Martin Entz, of the University of Manitoba, believes many producers unable to make the transition to organic farming will be attracted to this approach as it allows the use of fertilizers and does not require the elimination of pesticides from the entire farming operation. Entz says that organic farmers in Manitoba have been supportive and are willing to work with this group, and contends that Pesticide-Free products will not compete with organic products for markets.
7.5 Summary and Conclusions

Research on sustainable agriculture conducted by federal and provincial agricultural institutions in Saskatchewan has been focused on scientific and economic analysis of farming practices. Quantitative investigations of productivity, profitability and selected environmental parameters are used to compare the sustainability of different types of farming systems. These are useful indicators. But in this approach, the social dimensions of sustainability have been relatively neglected, which are equally important and strongly linked to ecological and economic variables. As a result of this omission, some important issues in Saskatchewan agriculture have not been well examined, such as the impacts of farming practices and agricultural technologies on the sustainability of family farms and rural communities, and the role of diversity of knowledge and approaches to agricultural sustainability.

This study was designed to develop a broader understanding of farm-level responses to the challenge of sustainability, as well as expand awareness and understanding of the social and political fabric that envelopes farming systems in Saskatchewan and which they are a part of. Zero tillage and organic farming systems, the local and external factors influencing these alternative practices and systems, and farmers' perceptions of sustainable agriculture were examined and compared. The findings of this investigation are briefly summarized below.

Both zero tillage and organic farmers made the transition to an alternative farming practice because of problems they identified with conventional farming practices. However, the problems that were identified and the responses to them differed significantly for these two groups of farmers. Declining soil quality, due to tillage and summerfallowing, was the major problem identified by the zero tillage farmers. Farmers also made the transition to zero tillage because of the economic and labour advantages of this approach. The negative impacts of synthetic pesticides and fertilizers on the environment (soil and water quality, wildlife populations) and on human health were the primary concerns of the organic farmers, followed by economic, philosophical/spiritual, and labour concerns.

Organic and zero tillage farms differed in size, diversity of production and management operations, the use of purchased inputs, labour, and land tenure. Organic farms tended to be moderate sized, diversified, crop and livestock operations, in which a variety of biological and cultural practices were used, rather than synthetically manufactured agrochemicals. The organic farmers owned most of the
land they farmed and tended to exchange labour with neighbours and family members rather than hire labour. In general, zero tillage farms were large, capital-intensive, specialized cropping operations that relied upon non-family hired labour. Although they owned much of the land they farmed, zero tillage farmers also had a significant proportion of rented land. Despite these generalized differences, it should be noted that there was considerable heterogeneity in the two groups of farming systems examined and some notable similarities between the two groups. For example, a large proportion of both zero tillage and organic farmers were developing diversified and extended crop rotations. Although tillage and summerfallowing were used by most of the organic farmers, many recognized the need to reduce the frequency and intensify of these practices, and approximately one-third had replaced summerfallowing with a leguminous green manure crop.

Social, economic and environmental advantages and disadvantages associated with the characteristics identified for these farming systems, and their implications for sustainable agriculture were presented and discussed. Important differences in the potential contributions of these two approaches to sustainability were noted in the following areas:

• diversity in both production and management aspects of the farming systems
• use of fossil fuels, and consequent carbon dioxide emissions, associated with the energy-intensive manufacturing of nitrogen fertilizers
• input costs and output prices
• the structure of agriculture: farm size
• the formation and reproduction of social capital

These findings indicate that organic farming offers relatively important contributions to the development of sustainable agriculture and can be seen as a potential strategy to sustain diversified family farms and rural communities.

Women in the study, whether from zero tillage or organic operations, shared similar concerns and responses to the impact of agrochemical use on human health. Some of these women were unable to influence changes in the use of farm chemicals in the commercial farm operation. In the domestic realm, however, women were able to act upon their concerns and to select or grow food without agrochemicals, choices they believed were conducive to sustaining the health of their family.
Most of the farmers in this study shared similar basic goals and perceptions of sustainable agriculture. Land stewardship and preservation of the family farm were of fundamental importance to both zero tillage and organic farmers. There were, however, differences in more specific criteria for sustainability identified by these two groups of farmers. Approximately 10 percent of the farmers conceptualized sustainable agriculture within the larger agri-food network. Twenty-five percent of the farmers were uncertain and/or cynical about the meaning of sustainable agriculture.

Due to differences in theory and practice, zero tillage and organic farming in Saskatchewan have involved very different networks of actors, which has influenced the divergent evolution of these practices within the discourse on sustainable agriculture. Zero tillage, compatible with the dominant agricultural paradigm and the industrial model, continues to be promoted by agricultural institutions and agribusiness as the best solution to farm-level sustainability. Organic agriculture is, however, playing an increasingly prominent role in the global agri-food system. It is now the fastest growing sector in agriculture, and it is also part of a global social movement, where concerns about health, food quality and food safety, land use and social justice have been linked in the design of an alternative paradigm for agricultural development. This social movement and this sector of the consumer base are influencing changes in the food system and in how we think about and approach sustainability. In Saskatchewan and elsewhere, the concept of sustainable agriculture remains contested and its definitions and applications are persistent sources of conflict. This study has shown that the development of sustainable agriculture is an on-going complex multidimensional process, involving a number of different actors and a range of issues.

Sustainable agriculture is a relatively new concept and needs further exploration and development of a number of different dimensions. In particular, there is a need to explore how the theory and practice of sustainable agriculture are being translated and developed in different locations. The overall task implied by the general concept of sustainable agriculture is to integrate human and ecosystem well-being. This is a task that requires concern and respect for the ecosystem and the people within it. The dominant discourse displays a bias towards a managerial approach to sustainable agriculture, stemming from the prevalent professional and hierarchical approach to knowledge construction. But the increasing resistance to this model of knowledge generation and transmission indicates there is a need for further dialogue and debate over the goals, objectives and approaches to sustainable agriculture. Social
movements can be expected to play an increasingly prominent role in the discourse on sustainable agriculture. Buttel (1997: 357) contends that "social movements are likely to be the primary mechanism for successfully affecting changes in the various political/economic feedback loops of the socialization of external costs and the development of compensatory technologies."

There are theoretical and methodological implications in the growing challenges to the hegemony of the formal knowledge system:

1. There is a need for more holistic and interdisciplinary approaches to the study of agricultural systems. A holistic systems perspective extends beyond agronomy, biology, economics and ecology to also include analysis of social phenomena. This type of analysis will require collaboration of natural, applied and social sciences.

2. Actor-oriented approaches need to be incorporated in order to explore and understand agricultural development as a social process and to give due recognition to individual perceptions and strategies. Ethnographic research is one such approach that provides opportunities for in-depth analysis of the social and ecological factors influencing farming systems. Bennett's work (1982), based on a decade of research in southwestern Saskatchewan, is recognized as one of the most thorough attempts to place farming practice within a social, ecological and cultural context. There is also a need for participation of a wider range of stakeholders in determining research priorities and agendas. In particular, farmers need to be recognized as important producers of knowledge. Merely offering farmers the opportunity to take part in research and extension will not, however, ensure their interests are being addressed. In order for scientists, extensionists and farmers to engage in meaningful dialogue and knowledge building projects, they will need to develop and adopt institutional frameworks and methodologies that take into account the complexities of socially and politically differentiated knowledge generation and transmission. Exploring the transmission and transformation of local knowledge is a key research theme of vital importance to agricultural extension. The network of different actors and institutions involved in this process demonstrates the importance of acknowledging social context and power relations in patterns of knowledge transformation and agricultural development.

3. Full-cost accounting methods can be used to evaluate the diverse impacts of agricultural technologies and policies. These approaches can provide information about the direct and indirect, short- and long-
term effects on ecological and socio-economic variables in agroecosystems (Gertler 1999). Both zero
tillage and organic farming practices have features that are beneficial to the development of sustainable
agricultural systems. Long-term studies are essential for examinations all the variables in the equation,
particularly ecological consequences, energy costs, and social impacts.

4. There is a need for more long-term agronomic research of a diversity of production practices.
Van der Ploeg (1993) argues that heterogeneity in farming systems presents a huge array of responses and
potential solutions to the challenges in agriculture. By maintaining diversity in agricultural production we
retain the capacity to be flexible and to respond to changes. He suggests that those who are interested in
the development of sustainable agriculture would do well to investigate how these alternatives are being
developed and reproduced. In Saskatchewan, there has been an emphasis within agricultural institutions
on high external-input approaches, such as zero tillage, precision farming, and biotechnology, as
solutions to sustainability. We need to foster a greater diversity of approaches to farming, particularly
low external-input approaches, such as organic farming.

Irwin (1995: 182) contends that “an investigation of sustainability is inseparable from questions
of knowledge and the status of science and local knowledge within competing notions of social progress.”
In the discursive view of knowledge and power presented in this thesis, emphasis is placed on the role of
human agency within socio-politically constituted networks of actors and their institutions. This study has
shown that processes of negotiation, compromise and resistance do occur and are important in initiating
change.
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APPENDIX A: OUTLINES OF INTERVIEW QUESTIONS AND TOPICS

A. Farm Operators

- number, age, gender, marital status of farm operators
- years of general farming experience
- post-secondary education
- describe the extent to which your farming operation is under zero tillage or organic farm management
- year transition began and was completed
- reasons for adopting an alternative farming practice
- sources of information and support for making the transition
- land base, proportions owned and rented
- labour base – farm operators
- members of the family with off-farm employment
- on-farm economic diversification
- non-family hired labour – part-time, full-time, farm versus farm-based business assistance
- type of production system – specialized or mix crop and livestock
- number and type of livestock
- crop profile
- crop rotation – years, crops
- methods of weed control
- changes in the use of purchased inputs since making the transition to an alternative farming practice
- involvement in formal research, agricultural and community organizations
- goals for the farming operation: size and diversity of farming operation, environmental, intergenerational transfer; personal goals
- perceptions of sustainable agriculture
- predictions about the future of farming in Saskatchewan

B. Participants from Public Agricultural Institutions

- education and work experience
- current employment position
- role of agricultural institutions in the development of agriculture-historic and contemporary
- institutional restructuring- effects on research and policy
- relationship between public agricultural institutions and private agribusiness corporations- effects on research and policy
- define sustainable agriculture
- do you think there is support for sustainable agriculture in agricultural institutions in Saskatchewan? identify specific programs, projects
- do you think farmers in the province are committed to the development of sustainable agriculture?
- what role if any do alternative farming practices, such as zero tillage and organic farming, play in the development of sustainable agriculture in Saskatchewan?
- what do you see as the benefits and the problems associated with these alternative practices?
- what role has and is the institution playing in the development of these practices?
- what role are agribusiness firms playing in the development of these practices?
- is there a partnership between public and private sectors in the development of these practices?
- what do you see as the future of agriculture in Saskatchewan?
C. Private Industry Participants

• education and work experience
• role of agribusiness in the development of agriculture in Saskatchewan, in general; and specifically what contribution has your firm made
• describe the types of partnerships that have taken place between your firm and public agricultural institutions in this province
• define sustainable agriculture
• do you think there is support, within both public and private sectors, for the development of sustainable agriculture? describe specific programs, projects
• what role if any do alternative farming practices, such as zero tillage and organic farming, play in the development of sustainable agriculture in Saskatchewan?
• what do you see as the benefits and problems associated with these alternative practices?
• Saskatchewan is considered to be a world leader in the adoption of zero tillage. Do you believe this is an accurate picture? If so, what factors would you identify as having contributed to this success?
• what do you see as the future of agriculture in Saskatchewan and what role will your industry play in this development?

D. Representatives from Grassroots Agricultural Organizations

• describe the constituency your organization represents and what the purpose of the organization is
• do you think there is much support, in general, for the development of sustainable agriculture in Saskatchewan?
• do you see sustainable agriculture as a social movement or part of a social movement?
• what role do alternative farming practices, such as zero tillage and organic farming, play in the development of sustainable agriculture?
• what do you see as the benefits and problems associated with each?
• what role do each of the following play in the development of sustainable agricultural systems: farmers, consumers, public agricultural institutions, agribusiness corporations, grassroots organizations?
• what do you see as the future of agriculture in Saskatchewan?
### APPENDIX B: BACKGROUND INFORMATION ON THE RESPONDENTS REFERENCED IN CHAPTER FIVE

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