Strategies to overcome institutional barriers to the transition from conventional to sustainable agriculture in Canada: the role of government, research institutions and agribusiness

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1.0 Introduction

This research project has been undertaken to support the development of a sustainable food system in Canada. Interest in sustainable agriculture is presently found throughout Canadian society. Farmers seek information on the transition process, consumers are buying the products of sustainable systems, new businesses are being created, public interest groups promote it, and governments are developing policy initiatives.

Proponents of sustainable agriculture are identifying ways to transform this interest into action and change. Although many positive proposals have come forward, a framework for assessing the viability and potential effectiveness and impact of such proposals has been lacking. Theory for the strategic promotion of sustainable agriculture remains at what Loehle (1988) calls the immature stage of theory development (i.e., imprecise, not operationally defined)(1). In this stage, a new paradigm is being formulated, methodologies are original, and the approaches reflect a high degree of risk-taking and philosophical experimentation and have yet to be formalized or institutionalized (De Mey, 1982). The main goal of this research project is to develop such a conceptual framework and to test some of the current proposals for developing a sustainable agriculture against it. Such an investigation will help to provide the sustainable agriculture movement with a process of critical discourse.

Achieving this result requires an extensive review of the sustainable agriculture and associated literature from a wide variety of academic disciplines and popular discussions, including political science, management, education, philosophy of science, psychology, ethics, sociology, ecology, and agricultural sciences and economics. In addition a number of interviews and workshops have been carried out with a variety of players in the food system.

This is an action research project because it aims to discover useful knowledge that people can use to improve their particular situation, and because the information produced by the project returns to the community that generated it (Reason and Rowan, 1981a; Allender, 1987). It is targeted primarily at sustainable agriculture proponents who work with (and are sometimes themselves) agricultural professionals active in agricultural development institutions (i.e., government, research institutions, agribusiness). This project is designed to help provide sustainable agriculture proponents with a coherent, comprehensive action agenda for overcoming the main agricultural institutional barriers to more

widespread adoption of sustainable agricultural practices and policy. The analysis is focused primarily on the sub-international level. Reform of international relations as they affect agricultural sustainability is not addressed.

In a study of this kind, the emphasis lies not with developing a specific hypothesis that can be quantitatively tested, but rather with identifying a research question for which answers can be found using a variety of techniques and indicators of validity and rigour (Miles and Huberman, 1984). "Qualitative researchers avoid going into studies with hypotheses to test or specific questions to answer, believing that finding the questions should be one of the products of data collection rather than assured *a priori*." (Bogdan and Biklen, 1982:55). States Loehle (1988:98), "It is very difficult to conduct a conclusive test of a theory's predictions when the theory is immature . . . Attempting to test an immature theory, or demanding that it be supported by strong evidence, shows a failure to understand the fact that the appropriate level of hypothesis testing depends on the level of theory maturity".

The two main (and related) research questions for this study are:

1. **What conceptual framework can be developed to assess the validity and viabililty of potential strategies to promote a sustainable food and agriculture system for Canada?**

2. **Using this framework, what strategies can be most effectively pursued by sustainable agriculture proponents to create a sustainable food system?**

In chapter one, the need for such an investigation in the Canadian context is provided. Chapter two contains a review of farm-level transition to sustainable agriculture and the implications of this process for institutional activity. The methodology of this study is provided in Chapter three and results in chapter four (and appendices). The results are translated into a narrative organized according to institutional areas in chapter five, and conclusions and further research needs are provided in chapter six.

1.1 Definitions

Widespread agreement on a definition of sustainable agriculture is proving to be elusive. The one used in this study is a product of the work of Hill (1985a, 1986b) and the USDA (1980). It aims to be comprehensive, positive and descriptive.

Sustainable agriculture is both a philosophy and a system of farming. It has its roots in a set of values that reflects an awareness of both ecological and social realities. It involves design and management procedures that work with natural processes to conserve all resources and minimize waste and environmental damage, while maintaining or improving farm profitability. Working with natural soil processes is of particular importance. Sustainable agriculture systems are designed to take maximum advantage of existing soil nutrient and water cycles, energy flows, beneficial soil organisms, and natural pest controls. By capitalizing on existing cycles and flows, environmental damage can be avoided or minimized. Such systems also aim to produce food that is nutritious, and uncontaminated with products that might harm human health.

In practice such systems have tended to reduce or avoid the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. These substances are usually rejected on the basis of their dependence on non-renewable resources, potential for environmental disruption, and possible adverse impacts on soil organisms, wildlife, livestock and human health. Sustainable agriculture

systems rely more on crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, appropriate mechanical cultivation or minimal tillage to optimize soil biological and natural pest control activity, and thereby maintain soil fertility and crop productivity. In addition, resistant varieties, and biological, biorational, and cultural controls are used to manage pests, weeds and diseases. Preventative health care strategies, such as dietary changes, increased exercise, and housing changes are employed to maintain animal health.

The potential of this approach, however, goes far beyond its present expression, which has largely been limited to the substitution of environmentally benign products and practices. More significant advances can be expected as a result of developments in the science and art of agroecosystem design and management.

This description encompasses a wide range of farming systems including those referred to as low-input sustainable agriculture (LISA), organic, biological, ecological, agroecological, biodynamic, regenerative, alternative, natural and permanent (permaculture). Although these systems are sustainable to differing degrees, all fall within the boundaries of the description above.

An institution, for the purposes of this study, is broadly defined as a place where people come together for communal purposes (Izumi, 1986). Institutions are places where many social choices are made (Dryzek, 1987). In this study, I am concerned with some of the institutions that make choices about agricultural development.

1.2 General history

Sustainable agriculture, according to Douglass (1984), has evolved from three perspectives: as a system of production to achieve food self-reliance; as a concept of stewardship; and as a vehicle for sustaining rural communities. The concept of sustainability is not new to farming practice, agricultural science, nor even to agricultural policy. It is now considered to have been a part of theory and practice in English agriculture for several hundred years until the mid-19th century. The repeal of the Corn Laws played a major role in the demise of sustainable practices because it signified a shift away from food self-reliance (Duncan, 1988). The back-to-the-land and vegetarian movements of 19th century USA helped shape perceptions of appropriate production practices, and of the kind of communities to support, and to be supported by, the development of sustainable systems (Peters, 1979). The term organic, as a descriptor for certain sustainable agriculture systems, appears to have been first widely used by Lord Northbourn (1940) in his book "Look to the Land". Northbourn used the term to describe farming systems that focused on the farm as a dynamic, living, balanced, organic whole, or an organism. The term, thus, had broader meaning than just the use of living materials to achieve farming objectives, a restrictive definition that is often erroneously implied today (Schofield, 1986). Its original meaning, then, is much closer to the origin of the term organic used in organic chemistry, the study of the chemistry of organisms. Unfortunately, many scientists continue to equate the term with the present-day meaning of organic chemistry, the study of carbon-containing compounds.

The term organic was first widely used in the USA by J.I. Rodale, founder of Rodale Press, in the 1950s. Rodale was both the popularizer of the term organic (and by implication notions of sustainability), but also, in the scientific community, the inspiration for the denigration of the term. Rodale failed to convince scientists of the validity of his approach because of his reliance on what were perceived to be outrageous unscientific claims of organic farming's benefits (Peters, 1979). This was unfortunate as a

number of scientists in the USA and Europe were investigating and promoting sustainability in agriculture at the time, most notably Sir Albert Howard (1943, 1947) and William Albrecht (1975). The scientific and governmental fascination with using agrichemicals, monoculture, and specialized equipment for food production severely constrained professional interest in questions of sustainability.

The German Nazi government seriously considering adopting sustainable agriculture practices as government policy during the Second World War. A number of senior government members were particularly influenced by the work of Rudolph Steiner (1924) and the German biodynamic farming community. They were attracted to the self-sufficiency of these farming systems, an element of strategic importance during wartime. The historical significance of this has not been fully explored, however, because the horror of other Nazi policies has limited historians' desire to evaluate the validity of potentially positive policy initiatives (Bramwell, 1989). It is a reminder, however, that the present government interest in sustainability in the 20th century is not necessarily an historical aberration.

One other important historical influence on the development of sustainable agriculture was the research on the connection between the condition of the soil, food quality, and human health. Some members of the medical community in the UK had been performing clinical research experiments on the subject since early in the 20th century. This community was of the view that human health was greatly negatively affected by poor soil management practices in agriculture, particularly poor organic matter management (McCarrison, 1943; Picton, 1946).

Although some scientists played a significant role in the early development of sustainable agriculture, almost all scientific disciplines have ignored it, with the notable exception of ecology and agroecology. Ecology as a scientific approach has only existed since the late 19th century (Worster, 1979; Lowe and Worboys, 1980; Fox, 1988), and agroecology research is less than 50 years old (Altieri, 1987). Ecology is concerned with the relationships between organisms (including humans) within ecosystems and with the associated flows of energy and materials. Agroecosystems differ from natural ecosystems in that they are partly powered by auxiliary energy sources (fossil fuels, animal and human power), human management has reduced species diversity, the dominant plant and animal species are artificially selected, and they are controlled by humans rather than through natural feedback mechanisms (Odum, 1984). Within the agroecological paradigm, the sociocultural elements are regarded as important because human relationships with agricultural systems are prime determinants of the form any given system takes (Hill, 1980; Norgaard, 1983). Concern for the whole and for the study of relationships as they exist within their natural environment are features that distinguish ecology and agroecology from most other scientific disciplines (Busch, 1984). Scientists, given a choice, strive for completeness of understanding, and the ecological paradigm is one of the few in common use that provides a reasonable opportunity to achieve this goal (Bahm, 1979; Jackson, 1984). Although agroecology has beens used since its inception as a means to help explain why sustainable systems are successful, agroecologists are now having an influence on our perceptions of sustainability. It is now apparent how agroecological principles can be used to design sustainable farming systems (cf. Patriquin et al., 1986; Lafleur and Hill, 1987).

Recently, concepts of sustainable yield in fisheries have contributed to our understanding of sustainability in agriculture. In fisheries, the focus has been on optimizing yields by ensuring that harvest rates equal replacement rates, thereby permitting harvest to continue in virtual perpetuity. Similar ideas are being applied to agriculture by emphasizing optimal replacement rates of soil, soil nutrients and organic matter, soil organisms, water, energy and genetic resources (Dover and Talbot, 1987).

1.3 The state of the sustainable agriculture movement in Canada

Canada's sustainable agriculture movement began in the early 1950s with the establishment of an Ontario-based organization, The Land Fellowship. Its principal leaders, Christopher Chapman and Spencer Cheshire, focused their activities on the production and dissemination of popular education in print and film. A few vocal producers, influenced by sustainable agriculture developments in Europe and the USA, also spoke out against the agricultural practices and policies of the period and promoted sustainable approaches. They received little attention from the agricultural establishment, although there was a slow but steady increase in interest in the farm community. This was particularly so in Quebec due to the presence of Europeans who had been practiciing sustainable practices before arriving in Canada (Hill, 1983; Thériault, 1988).

In the 1970s, many environmental and sustainable agriculture organizations were created in response to the nascent global concern about the environment. All of these organizations started with small budgets and largely volunteer labour, but did have an impact on the media and the public consciousness. Most initially focused their activities on local issues, and relied on local financial support for their survival. The 1980s have witnessed a dramatic increase in the number of organizations and promotional initatives, increased levels of funding from public and private sources for some, and, in some cases, a greater degree of influence over public policy.

Canada now has over 100 private and para-governmental organizations involved in promoting sustainable agriculture, encompassing a wide range of sizes, organizational capacities, and goals. These groups are of various ages, have budgets of a few thousand to a few hundred thousand dollars, focus on local or national issues, and have zero to substantial influence on the thinking of provincial or federal governments. This diversity is both a strength and a weakness for the movement. There are now groups addressing agricultural problems in most parts of the country, but much of their activity remains uncoordinated and in some cases counterproductive and contradictory. One organization's proposal for change, although in its own context a valuable contribution, can have a negative impact on that of another. Few organization's have a profound analysis of how a sustainable agriculture can be achieved in Canada. The movement is not yet acting in a unified fashion, although a number of initiatives to address this problem are underway.

1.4 The present state of agricultural institutional involvement in sustainable agriculture

Henderson (1987), among others, has described our current Western political institutions as suffering from a breakdown of purpose, activity and credibility. Some have argued that we have evolved economic, social and cultural institutions that are removed from ecological realities and consequences, and are, thus, contributing to the present ecological crisis (Bernstein, 1981; Dryzek, 1987). The rapidly changing economic, cultural and ideological environment is forcing institutions to reexamine their raison d'être. Many are successfully adjusting, others are becoming more rigid and defensive, attempting to do more of the same things that have produced the present state of affairs.

Canadian agricultural institutions are a part of this general phenomenon. Until very recently, few agricultural institutions had expressed much interest in sustainable agriculture. As of 1987, no Canadian provinces or the federal government had any explicit policies and programs to support sustainability.

Many producers following sustainable practices were having trouble receiving support from government programs and personnel (Kramer, 1984; Robinson, 1986), including some difficulties obtaining credit and crop insurance. No universities were offering courses and programs in sustainable agriculture, although a few professors were carrying out research projects in the field, and including some of the concepts in their courses. The conventional food distribution sector was largely ignoring the growing consumer interest in organic and residue-tested foods.

Since 1987, however, there have been some dramatic changes. Most Canadian provinces and the federal government have undertaken important initiatives (Table 1). Most provinces have been modifying their extension services to provide support to producers interested in undertaking a transition to sustainable practices. Several are providing research funds. Three are developing legal frameworks to support the certification of organic foods. Prince Edward Island has a pilot project to subsidize the transition period. The federal government has been reviewing how all of its policies, programs and regulations have an impact on sustainability (Agriculture Canada, 1989a), and will likely also develop legislative supports for the use of the term organic in the market place (Ad hoc Committee on Natural and Organic Foods, 1990). Agriculture Canada is funding several research projects.

Two universities now offer programs in sustainable agriculture, and the rest are investigating the possibility of doing so. Several science and economics funding agencies are financing sustainable agriculture research projects.

Alternative food outlets have been distributing organic food for many years, but now the conventional food sector has begun to market organic foods.

The major Canadian retail chains are all experimenting with organic food sales (Sobey's, Provigo, Steinberg, Loblaw's, Safeway). Provigo is selling produce tested for pesticide residues by a private company. A few conventional sector processors are coming out with new organic products. In urban areas it has been estimated that 25% of the population would buy primarily organic vegetables if the price was within 25% of the conventional price (Baseline Market Research, 1988). Growth in the organic food sector is estimated at 25% (Christianson, 1988). Agribusiness interest in this sector is expected to grow considerably as a result.

1.5 Driving forces for sustainable agriculture

The interest in sustainable agriculture is driven by three main concerns: that our present agricultural practices are having a negative impact on environmental quality, and on resource availability and use; that these practices are contributing to a deterioration in human health; and that the economic situation for producers continues to decline.

The negative environmental impacts of current agricultural practices include soil degradation, water depletion and contamination, inefficient energy use, loss of plant and animal genetic diversity, and destruction of non-agricultural habitat (Pimentel and Pimentel, 1979; Hodges and Schofield, 1983; Canter, 1986; Hallberg, 1986; Papendick et al., 1986; Science Council of Canada, 1986; Arden-Clarke and Hodges, 1987, 1988; Arden-Clarke, 1988; Soule et al., 1990). Certain products and practices are implicated in human health problems, including animal antibiotics (Holmberg et al., 1984, 1987; Spika et al., 1987), nitrates in groundwater (Fleming, 1987; Power and Schepers, 1989; Strebel et al., 1989), pesticides exposure in an occupational setting (Center for Rural Affairs, 1984; Hoar et al., 1986; Blair,

1990; Wigle et al., 1990), pesticide residues in foods (Mott, 1984; Clancy, 1986; National Research Council, 1987), many food additives (Lawrence, 1986; Pim, 1986), and certain food processing techniques, such as removal of fibre from grains, addition of salt, refined sugar, and boiling in fat, oil or water (Hall, 1974; Silverstein, 1984; Grimme et al., 1986; Gussow and Clancy, 1986). Although considerable scientific controversy remains, there is some evidence to suggest that conventional soil management practices are contributing to declining nutritional value in foods (Voisin, 1959; Albrecht, 1975; Petterssen, 1978; Knorr and Vogtmann, 1983; Linder, 1985; Bishop, 1988).

The Canadian farm economy has been suffering for a number of years. Farmers in the Western world are caught in a cost-price squeeze in which they have little control over input or output prices (Martinson and Campbell, 1980; USDA, 1981; Youngberg and Buttel, 1984b; Buttel et al., 1986). Input prices have been rising more rapidly than input productivity or output prices (Cox, 1984; Myers, 1988a). Net farm income has been flat, and massive government subsidies have been required to prevent numerous farm failures. In 1987, 12.5% of farmers holding Farm Credit Corporation loans were thought to be in financial difficulty and 3.3% insolvent (Agriculture Canada, 1987a). Ten thousand farmers in Saskatchewan alone are facing the threat of foreclosure in 1990 (York, 1990). Farm bankruptcies have occurred at the highest level since the Depression, and one estimate has seven farmers leaving farming for every one that remains to go bankrupt (Pugh, 1987a). Some USA investigators have concluded that 3-5 jobs are lost per farm failure, and that one rural business fails for every 6 farms that go out of business (Ritchie and Ristan, 1987). These financial stresses have had negative impacts on the rural economy and rural social fabric (Vogeler, 1981; McClatchy and Abrahamse, 1982; Troughton, 1985; Heffernan, 1986; Allison et al., 1987), and on the stress levels and health status of farm families (Haverstock, 1987; Walker and Walker, 1988).

Sustainable agriculture is perceived in many circles to provide solutions to most of these problems. Sustainable production systems substantially reduce erosion, principally due to the use of sophisticated crop rotations and organic matter management techniques (Cacek, 1984; Arden-Clarke and Hodges, 1987; Reganold, 1988), and surface and groundwater contamination (Cacek, 1984; Fleming, 1987; Papendick et al., 1987; Agricultural Law and Policy Institute, 1988). The use of toxic materials in production is very low in comparison to conventional systems, so the environmental and health problems associated with their use do not occur. Energy use in sustainable systems may be reduced by up to 60%, depending on the region and production system (Coxworth and Thompson, 1978; Lockeretz et al., 1981; Ministère de l'Energie et des Ressources, 1989; Pimentel et al., 1989). Many producers use older, sometimes rare, crop cultivars and animal breeds because they find them more appropriate in their production systems (Buchting et al., 1986; Kiley-Worthington, 1986; Patriquin et al., 1986; Frost, 1989; Martin, 1989a). Diversified crop production systems, windbreaks, and the more diversified landscape associated with sustainable agriculture systems often contribute to improved and varied wildlife habitat (Cacek, 1984; Cacek and Langner, 1986; Arden-Clarke, 1988).

There is now considerable evidence suggesting that farmers using sustainable practices can have a net income at least as high as, and sometimes higher than, they did as conventional producers, or in comparison with their neighbors producing conventionally (Table 2; National Academy of Sciences, [bookmark from econom.web] 1989). The New Farm magazine, which maintains a substantial database on farmers practicing sustainable practices, found in a 1984 survey that 88% of the 213 farmers surveyed reported incomes as good or better after transition from conventional management (Brusko et al., 1985). This situation exists even though yields in many crops may be lower (in general 10% across all crops [Stanhill, 1990]), as illustrated in Table 3. Three factors usually account for this. First, operating costs

may be up to one third lower (Lampkin, 1986a), particularly for energy, chemicals and drugs. These costs are on average 10% of assets for sustainable producers as compared with 33% for those farming conventionally (Ehrenfeld, 1987). Second, where premium prices are available, as in the case of many organic farmers, the likelihood of a superior net income situation is even greater. Premium prices in North America generally are 10-50% above average[(2)] , and there is evidence that 30-50% of organic farmers receive a premium for their produce, depending on the commodity (Lockeretz et al., 1981; Blobaum, 1983; Parr et al., 1983; Kramer, 1984; Taillefer, 1989). In Europe, premium price levels can even be higher, especially for fruits and vegetables (Geier and Vogtmann, 1984; Peter and Ghesquière, 1988). Finally, many organic farmers achieve higher net income by making more direct linkages with consumers. Survey data suggest that organic farmers are more likely than conventional ones of comparable size and description to direct market (Geier and Vogtmann, 1984; Kramer, 1984; Teichert and Schulz, 1987; Cook, 1988; Peter and Ghesquière, 1988). By avoiding traditional marketing channels, farmers have been able to realize a much greater percentage of the consumer dollar (Schaaf, 1983; Rocky Mountain Institute, 1986b). For example, a study in Colorado found that farmers received 44% higher gross [Bookmark from econom.web] returns with direct marketing techniques compared to selling to wholesalers (U.S. Bureau of Census, 1980 cited in Duhl et al., 1985). As a consequence of the favourable imcome position of many organic producers, the overall financial health of the operation is improved. Lockeretz and Madden (1987), in a survey of Iowa organic farmers, found that none had debts exceeding assets. Six percent of all Iowa farms did have debts exceeding assets.

Although net income may be higher, income per labour unit may actually be lower for organic producers, since organic farming tends to be more labour, and management intensive (Lampkin, 1986a; Wagstaff, 1987). Commonly, this need for extra labour is internalized within the family, although there is an opportunity cost and a choice to be made between increased labour on the farm and off-farm opportunities (Kramer, 1984). However, for many organic farm families, the increase in hours spent on the farm or marketing the produce has monetary as well as non-monetary rewards. Many consider that the extra time allows them to be more in tune with the ecological processes of the farm and contributes to their management skills (Kramer, 1984; Brusko et al., 1985).

Existing studies analysing the impact of a major shift to sustainable agriculture have concluded that significant benefits would result, including improved food quality, enhanced environmental and human health, higher net farm income, and lower government subsidy payments and crop storage costs (Oelhaf, 1978; USDA, 1980; Langley et al., 1983; Vogtmann, 1984; Cacek and Langner, 1986; World Commission on Environment and Development, 1987). The effect on consumer food prices has been projected to be minimal (1% increase in total food expenditures [Oelhaf, 1983]) or substantial (up to 99% increases in some commodities [Langley et al., 1983]). Farm employment and farmer numbers could increase (Cornucopia Project, 1984; Enniss, 1985) and small- to medium-size farms could become more viable (CAST, 1980). There is concern about the availability of labour, however, as more conversions take place (USDA, 1980; Langley et al., 1983). The impact of widespread conversion on the environment of any particular region has not been well explored to date (Lowrance and Groffman, 1987).

There is insufficient data at this point to fully assess the implications of this potentially improved financial situation for farmers using sustainable practices. In surveys, farmers have identified lower stress levels and improved family health as reasons for converting their operations and continuing to follow sustainable practices (Blobaum, 1983; Kramer, 1984; Robinson, 1985, 1986). To conclude, however, that rural communities would be more viable is premature in the absence of sufficient numbers of sustainable producers in any given locale. Lockeretz (1989a), using data from existing microeconomic studies

concludes that lower production levels in sustainable systems may result in lower short-term economic benefits for farming communities. However, because a greater percentage of the value of production remains in the community, greater long-term financial benefits may result from sustainable systems, particularly as production methods improve.

1.6 Theoretical foundations of sustainable agriculture

Sustainable agriculture and agroecology concepts and practices developed, as discussed above, on somewhat independent paths, but agroecology is increasingly recognized as the scientific discipline that best explains the successes and potentials of sustainable systems. Using the agroecological paradigm, four essential system properties of agroecosystems have been determined: productivity (level of output); stability (constancy or persistence of output over time); sustainability (recovery from stress, disruptions); equitability (eveness of distribution among various groups) (Conway, 1985).

These properties are bounded by certain essential ecological laws or principles (Commoner, 1970). The contraventions of these principles by our food system (Table 4) produce the effects outlined in the previous section. Resolving such problems involves mimicking natural ecosystems (Hendrix, 1987). "A `correct' agriculture, from an ecological point of view, should reflect . . . the integrated, mutually dependent, symbiotic relationships of coevolved species in a natural ecosystem" (Callicott, 1988). Basing agriculture on these (and other) ecological principles contributes to sustainable production in perpetuity (Dover and Talbot, 1987). Put another way, employing production practices that a) promote community stability; b) optimise the rate of turnover and recycling of organic matter and nutrients; c) optimise multiple use of the landscape; d) optimise energy flow efficiency, are most likely to ensure sustainability (Altieri, 1987). For example, the application of synthetic N fertilizers or high levels of raw manure in simple cropping systems (i.e., no or minimal rotation) often changes the nitrogen cycle dynamics, effectively resulting in a breaking of the cycle and N pollution (Arden-Clarke and Hodges, 1988). Generally, in such circumstances, 15-70% of the applied N can not be absorbed by living plant tissue, microbes or the soil physico-chemical complex (Terman, 1979; Hendrix, 1987; Radke et al., 1988). The excess soil nitrate changes population dynamics, suppressing the activity of organisms that function in a low soil nitrate environment (Mosse, 1986; Arden-Clarke and Hodges, 1988; Patriquin, 1988b). A system that respects the cyclical nature of soil-plant-microbe relations would not usually use synthetic N fertilizers or raw manure. N fertilization would depend on legumes in rotation, composted manure, and well synchronized cropping sequences to coordinate plant cycles with excesses and deficiencies of soil nitrogen (e.g., fall cover cropping to absorb excess nitrate in the soil), and to minimize losses (cf. Patriquin et al., 1986; Power, 1987a,b; Radke et al., 1988).

Agroecological theory also concerns itself with socio-cultural issues. Human relations and their relationships with their environment are as essential to the sustainability of agroecosystems as are the other biotic and abiotic factors that constitute a farm. A central purpose of sustainable systems is to support self-reliance and rural community viability (Douglass, 1984). Consequently, socio-economic and political systems (or social choice mechanisms) that complement agroecological principles are sought (Norgaard, 1984; Schultz, 1985; Dryzek, 1987).

A number of detailed treatments of agroecological theory are available (Cox and Atkins, 1979; Lowrance et al., 1984a,b; Altieri, 1987; Dover and Talbot, 1987; Mollison, 1988; Carroll et al., 1990; Gliessman, 1990).

1. This problem is not unique to agriculture. Robinson et al. (1989) have identified the absence of ecological and social theory as a principal obstacle to the development of a sustainable society in Canada.

2. Transient 250% premiums have been reported in Québec (Henning et al., 1990).

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2.0 Review of literature on farm transition from conventional to sustainable agriculture and implications for institutional activity

The foundation of Canada's transition to sustainable agriculture rests on converting farms from conventional to sustainable production practices. Canadian agricultural institutions have the mandate to assist, directly and indirectly, the production and marketing of agricultural products. To successfully support the transition, these institutions will have to understand the process of farm-level transition.

Many schools of thought fall under the umbrella of sustainability. The literature on transition is, as a result, somewhat confusing as each school of thought presents different ideas on the transition process. To help clarify this, schools have been categorized according to Hill's (1985a) efficiency / substitution / redesign spectrum (Figure 1). In the efficiency stage, conventional systems are altered to reduce consumption of costly and scarce resources, e.g., by banding fertilizers, monitoring pests, optimal crop siting and timing of operations. In the substition phase, resource-dependent and environmentally impacting products are replaced by those that are generally more environmentally benign, e.g., synthetic nitrogen fertilizers by organic sources, pesticides by biological controls, moldboard plows by chisels or discs. Finally, the redesign stage is achieved when the causes of problems are recognized, and thereby prevented, being solved internally by site and time-specific design and management approaches instead of by the application of external inputs, e.g., the farm is made more ecologically and economically diverse and therefore also more resource self-reliant and resilient.

2.1 Attitudes toward the transition and rationale

Why do farmers convert and how are they affected by the transition process? Until recently, the prime motivation has been fears about environmental degradation (particularly of soil and water) and deteriorating human health, often of someone within the immediate family (Blobaum, 1983; Hill, 1984a; Robinson, 1985; Bateman and Lampkin, 1986). Now, however, the depressed economic situation is causing more and more farmers to look to alternative farming practices as a way to cut input costs and maintain or recover financial health.

One common, although not prerequisite, motivational change among farmers in transition concerns the way they view their farm and the practice of farming. Many experience a major shift in their values and place even greater emphasis than before the transition on their role as guardians of both human health, through the provision of essential nutrients to consumers, and the health of the rural community and environment (Lockeretz, 1988). Another common change is that farmers become more aware of the "organismal" nature of the farm, which functions well when all its components are present and when essential biological processes are supported through the careful management of events in time and space (Koepf et al., 1976). Because of the uniqueness of each situation, and because of the changing nature of environments, there can be no reliable formulae for successful transition. Farmers must aspire to be sufficiently competent to respond appropriately to their own unique set of changing conditions. In this sense, successful transition usually requires that farmers become researchers and that their farms become experimental farms (Koepf et al., 1976; Hanley, 1980; Peters, 1987a). Several publications have been written to support them in this task (cf. Pettygrove, 1976; Levitan, 1980; Brusko et al., 1985; Rzewnicki et al., 1988).

Many farmers have found the transition process to be an unsupported, isolating, and stressful experience. Relevant government support has been usually lacking (Oelhaf, 1978; Lampkin, 1985a; Henning et al., 1990) and ridicule by neighbours and professionals has been common. Because farmers have had difficulties obtaining relevant information from conventional sources, they have tended to rely instead on other farmers (at field days, conferences), sellers of alternative products, on-farm experiments, popular organic-farming magazines, and classic, largely European, literature from several decades past (Hanley, 1980; Blobaum, 1983; Kramer, 1984; Robinson, 1985; Baker and Smith, 1987). These classics include scholarly works by Howard (1943, 1947) and Albrecht (1975) and more popular discussions by Steiner (1924), Bromfield (1947), Sykes (1949), Hainsworth (1954), Turner (1955), Voisin (1960), and Balfour (1975).

Most converting farmers come to regard transition as an on-going process that requires a high level of commitment (Robinson, 1985; Blake, 1987). Those who do not take this view are more likely to give up or experience difficulties (Plakholm, 1985; Lockeretz and Madden, 1987). The articulation of clear goals, both for themselves and their farms, and the development of plans for their achievement, are the prerequisites of success (Hanley, 1980; Brusko et al., 1985; Hart, 1989). Such plans may include an anticipated period of reduced profits during the transition period, when attention is focussed on ensuring financial liquidity, flexibility, and evolution of the new systems of production (Côté, 1986).

2.2 General elements

Transition generally proceeds along two lines (although combinations are also common). Some producers proceed by following an efficiency / substitution / redesign progression on a field or whole farm basis. For example, a grower may first band chemical fertilizers instead of broadcast, or reduce fertilization levels on all parts of the farm (efficiency). In the next phase, if the results are promising, manure or compost will be applied (substitution). In phase three, legumes are undersown and a planned rotation is put in place (redesign). Alternatively, the grower may go right to the redesign stage, but start with only one field and progressively adopt the new design for the whole farm (Figure 2). With this approach, it is generally advisable to start on a small part of the farm, perhaps 10% of the cultivated area (Brusko et al., 1985; Wookey, 1987), although some recommend up to one-third (Preuschen, 1985). Ideally, these phases are seen as part of a continuum, but this does not mean that sustainability is not

improved by stopping at earlier stages. Farm structure and soil fertility often determine the speed and extent of transition. For example, pastures that have received little or no synthetic fertilizers and pesticides can convert quickly to the redesign stage (Aubert, 1973; Preuschen, 1985), especially when they are part of a beef operation (Pousset, 1981). Whole-farm transition (cold turkey) to redesign is advocated by some because the effects of alternative strategies are easier to see in the absence of conventional inputs and practices (Manley, 1988). Although such approaches have been successful, they are usually also traumatic and may, in fact, lengthen the transition period because of unanticipated side effects (Patriquin et al., 1986).

The transition to redesign usually takes from three to six years. One proposed explanation for this is that the toxic residues associated with conventional methods of production may prevent certain biological processes from reaching a new, necessary equilibrium (DeBach, 1974). Decomposers of organic matter in soil and natural controls of pests may be affected by these and other impacts, and this can translate into yield and income losses for up to six years (USDA, 1980; Dabbert and Madden, 1986). In many cases, however, yields and/or net income recover in two to three years (Oelhaf, 1978; Brusko et al., 1985; Dobbs and Mends, 1990).

Producers wishing to convert, regardless of the stage, will benefit by developing a detailed plan that, although being specific to their situation and needs, includes at least the following elements: agrichemical reduction strategies; soil improvement measures; manure or slurry handling methods; development of a crop rotation; fertilizer/manure applications; tillage alterations; livestock stocking-rate adjustments, if animals are involved; weed, pest, and disease control techniques; mechanization, housing, and storage requirements; marketing opportunities; labour requirement estimates; yield estimates; financial estimates and implications; and a timetable for transition (Lampkin, 1985a; Plakholm, 1985). Aubert (1982) has warned against the common tendency to adopt automatically what has been successful elsewhere, thereby ignoring the unique features and situation of each farm. Many Canadian producers have learned by experience that practices used in Europe or in the USA are not directly transferable to their conditions (Robinson, 1985).

2.3 Specific elements

2.3.1 Agrichemical reduction

Efficiency strategies for agrichemical reduction generally have been well-researched. An impressive volume of data and experience indicates that sizable reductions in agrichemical use, input expenditures and pollution can be achieved with reasonable ease. For example, Schriefer (1984) has demonstrated how to reduce N fertilizer use by banding within 15 cm of the base of the corn plant when carrying out a cultivation operation. Other successful strategies include timing N applications to coincide with maximum uptake periods (e.g., top dressing corn in summer, or winter wheat in spring), using controlled release N fertilizers such as sulfur coated urea, and more accurate soil testing to reduce over-application (cf. Cramer, 1986; Papendick et al., 1987). P and K fertilizers, at low applications, are often more efficiently used by the plant when the material is banded rather than broadcast (cf. Cramer, 1986; Randall and Hoeft, 1988).

Herbicide banding is now a well-established system of reducing chemical use and costs while maintaining or improving weed control (as compared to broadcasting), especially when combined with cultivation, Such systems have been found effective in soybeans (cf. Beattie et al., 1985) and corn (cf.

Samson, 1989), Canada's principal row crops receiving herbicides.

Great strides have also been made in insecticide reduction with Integrated Pest Management (IPM) programs. Unfortunately, success has been restrained in many cases because of excessive focus on the pest instead of on an ecologically-sound control system (Martin, 1989b). In other words, IPM as presently practiced is not in itself sustainable agriculture, but rather a component of an integrated system of production.

2.3.2 Rotation

The most critical elements of the transition to redesign are changes to soil management and the design of the cropping sequence. The selection of optimal crop rotations is central to successful sustainable farming and is the key determining factor for soil management, weed, pest, and disease control, animal feeding, and ultimately finances (Lampkin, 1985a). There may be a need to adjust the crop rotation over time as new crops and biological processes exert an influence on each other, and as market conditions and opportunities change. Normally these kinds of adjustments are minimal if the farm has been employing appropriate rotations for some time (Aubert, 1973; Dabbert and Madden, 1986).

Legumes are essential in any rotation and in many cases comprise 30-50% of the cropland (Parr et al., 1983). They can be used as cover crops, green manures or forages (clovers, vetches, trefoil, and alfalfa), as seed to be sold (clovers and alfalfa), as animal feed (fababeans), or as human food (peas, beans and lentils). Seed legumes are avoided between other essential marketable crops, however, because they favour development of weeds (Schmid, 1978). Pasture can also be part of the rotation, its composition depending on its purpose. If it is for animal feed, it can contain a wide variety of species (grasses and legumes) to be nutritious and palatable to animals (Aubert, 1973; Rodet, 1979; Murphy et al., 1986). Pasture renovation costs can be minimized by using a rotational grazing system (Murphy et al., 1986). Well-managed pastures support a diverse plant population, but under conventional grazing certain species are suppressed. Animals select the most palatable species, leaving other plants to dominate the pasture. The rotational system moves animals through small paddocks at a rate that forces the animals to eat most of the plants. The result is that one plant species is not favoured over another. If the pasture is being used to control weeds, then its composition should be less diverse. Pure stands of alfalfa, rye, or buckwheat are often used to choke out persistent annual weeds (Hanley, 1980). Green manures can be used in rotations for erosion and weed control, and to improve soil physical properties (MacRae and Mehuys, 1985; Vogtmann et al., 1986). Vogtmann et al. (1986) have provided rules for designing an effective transition rotation (Table 5) and for selecting rotation crops in relation to preceding crops (Table 6). They recommend that legumes, pasture, and root crops precede grains.

2.3.3 Nitrogen

The availability of nitrogen is critical at the beginning of the transition. Lampkin (1985a) has provided an example of a rotation N budget developed as part of a transition plan (Table 7). The negative N balance is not a problem in this example because the manure from the livestock that graze on the pasture (Years 1 and 2) and feed on the grains (Years 3 and 4) is returned to the soil. The spring beans (Year 5) must be fed to the livestock, however, to ensure a proper N balance. Patriquin et al. (1986) came to the same conclusion in their studies in Nova Scotia of a converting farm that used fababeans as a feed source for chickens. In their study, the crop rotation alone could not sustain adequate N levels because most of the N fixed by the fababeans was fed to the chickens (Figure 3).

It is common, however, for converting farmers to be so concerned with N that they inadvertently apply it in excess in the form of manure or other "organic" inputs. Excessive N, regardless of source, is likely to suppress biological activity (including mycorrhizae and possibly associated P uptake by plants [cf. Mosse, 1986]), reduce nodulation in legumes, give a competitive advantage to the weeds over the crop, and increase pest incidence (Chaboussou, 1982; Coleman and Ridgeway, 1983; Patriquin et al., 1986, 1988; Patriquin, 1988a,b; Rabbinge and Zadoks, 1989).

2.3.4 Tillage

Most converting farmers alter their tillage practices to reduce soil degradation and losses by erosion, improve control of weeds and other pests, produce more timely residue decomposition and especially to improve soil fertility. The approaches used (Table 8) depend on the farmer's knowledge, access to equipment, and on the farm's particular economic and environmental conditions (Schriefer, 1984; Brusko et al., 1985).

The main aim of tillage changes is to provide optimal conditions for beneficial soil organisms, thereby enhancing organic-matter decomposition and nutrient cycling. Managing the top 8 cm of soil is vital because most of the biological activity, microorganisms, and organic matter is found in this soil layer (Hill, 1984b; Preuschen, 1985; Kourik, 1986). As a result, most producers using sustainable farming techniques rarely use the traditional moldboard plow, favoring instead chisels, discs, and harrows which loosen and mix the soil in the top 25 cm rather than invert it (Parr et al., 1983; Schriefer, 1984; Brusko et al., 1985). Chisel plowing has limited application, however, in areas with moist fall conditions, such as Eastern Canada (Lobb, 1986). Another popular technique is to create ridges after primary tillage in the fall. Ridges help warm up the soil in the spring and encourage decomposition of crop residues and any green manures incorporated the previous fall (Schriefer, 1984). Some producers plant on the ridges if the soil is particularly wet (Schriefer, 1984; Moore, 1986; Little, 1987). Patriquin et al. (1986) found that ridging, by improving aeration, helped solve chronic organic-matter decomposition problems experienced in the transition period and as a consequence increased yields.

In some cases, compacted soil must be loosened by using deep chisel tillage or a subsoiler. Alternatively, a deep rooted green manure crop such as alfalfa or sweet clover may be helpful in breaking up hardpans (Hanley, 1980; Lampkin, 1985a). However, because alfalfa has a high K demand it must be managed to prevent K deficiency in subsequent crops (Vogtmann et al., 1986). Tillage alterations may add to total tillage expenses if more passes over fields or specific equipment are required (Enniss, 1985; Lampkin, 1986a).

2.3.5 Livestock

In operations with livestock, stocking rates are gradually adjusted to balance feed self-sufficiency and nutrient cycling. In Europe, redesign stocking rates of 1.0-1.2 Livestock Units (LU)/ha are recommended (Koepf et al., 1976; Lampkin, 1985a; Plakholm, 1985), or roughly 80% of conventional rates (Vine and Bateman, 1981). On small farms, because farmers often focus on higher-value crop products, even lower stocking rates are common (Blake, 1987). Stocking rates are likely to be lower on many North American farms (Brusko et al., 1985; Robinson, 1985), especially on range land where rates of 0.1 LU/ha are common (Jackson, 1987), although rates similar to those in Europe have been recommended in Saskatchewan (Hanley, 1980). Recent work, however, on rotational-style grazing systems, which divide

pastures into smaller areas and rotate animals through them quickly to facilitate the pasture's rapid recovery from grazing, suggests that stocking rates can be considerably higher (Murphy et al., 1986; Murphy, 1987; Savory, 1988). The recommended stocking rate for hens is <120 hens/ha, depending on the type of operation (i.e., deep-litter floor, aviary, or free range) (Fölsch, 1986).

Because farms often diversify during the transition period, ending up with more than one livestock operation, the total number of animals is often higher than on conventional farms, even though stocking rates per animal species may be lower (Brusko et al., 1985; Robinson, 1985). Different livestock operations can be designed to be complementary to one another. For example, adding a dairy-goat operation to an existing cow herd may provide new market opportunities and the goats will eat weeds and pasture grasses that cows may reject (Considine, 1979). Sheep may be added to a dairy-cow operation at a 1:1 ratio without requiring any additional grazing area (Blake, 1987). The costs and benefits of multispecies grazing have been discussed in a volume edited by Baker and Jones (1985).

When adding livestock to complement a cash cropping operation, labour-saving animal operations are desirable. For example, a beef finishing or sheep breeding and finishing operation requires less investment and labour than a beef or dairy cattle breeding operation (Pousset, 1981; Boggs and Young, 1987). Finding complementary livestock operations for ornamentals and fruit production has been less successful, although integrating ground-feeding birds, such as chickens and geese, with fruit trees has been suggested for weed and insect control (Lafleur and Hill, 1987).

2.4 Initiating the transition

1. Chemical needs are reassessed. Soil is tested, chemical applications are reduced, timing of applications is changed.

2. The soil is subsoiled if compacted. Chisel plows and subsoilers are most commonly used.

3. The soil revitalization process is started with an intensive fertilization program. Coleman (1989) has recommended using 50 tons / ac of compost or manure on a soil of low fertility, or 20 tons / ac for one of high initial fertility. Improvements to the manure management program are usually required to ensure access to high quality fertilizer. Other minerals may also be necessary, such as rock phosphate and greensand. Liming to pH 6.5 may be required.

4. Legumes are worked into the rotation as soon as possible.

5. The new rotation is started with a suitable crop. For non-horticultural operations, the best ones appear to be pasture, a hay crop, or annual legume (Aubert, 1973; Pousset, 1981; Blake, 1987; Peters, 1987a), although with the present economic situation in North America, a small grain or soybean crop may be the best compromise between biological and economic needs (Dabbert and Madden, 1986; Duffy, 1987; Liebhardt et al., 1989). Wookey (1987) achieved both objectives by starting his transition with a spring barley undersown with a clover/grass mixture that became a pasture following barley harvest. Early in the transition, corn should be avoided because it is too nutrient-demanding and delays soil improvement (Aubert, 1973; Vogtmann et al., 1986; Liebhardt et al., 1989). Some have suggested, however, that corn (or sugar beets in Europe) be left in the rotation at the beginning in order to help finance the transition period (see Figure 2). For horticultural crops, the choice of starting crop may not be as critical as the soil building program (although the two are definitely related). It can be advisable, however, to start a vegetable rotation with legumes or non-legumes of modest nutrient demand that can be undersown, such

as beets or carrots. In fruit production, manure, compost, green manures, mulches, foliar fertilizers, and rock powders can all be used to begin the fertility transition program (Oelhaf, 1978; Hall-Beyer and Richard, 1983; Page and Smillie, 1986; Reinken, 1986). However, soil fertility problems in orchards are invariably minor (although certainly connected) compared with those associated with pests, diseases, and labour costs (Oelhaf, 1978; Pimentel et al., 1984). Page and Smillie (1986) have provided a week-by-week guide to help fruit producers make the transition to sustainable practices. Eventually, however, sustained orchard production will require design changes involving selection of site, species and cultivars, management of adjacent and ground vegetation, pruning, integration of livestock, and timing of operations (Hill, in press).

6. The soil is covered for the winter as soon as possible to limit nutrient losses and erosion. A useful objective is always to keep the soil covered with green (growing plants) or brown (dead organic matter) material.

7. For operations with livestock, gradual stocking rate adjustments are usually required.

2.5 Risk in transition

The process of converting a conventional farm to sustainable practices can be financially difficult, and consequently it is a period during which finances are stretched and lenders are likely to be wary of providing credit. In this sense, the transition process appears to be one of taking on additional financial risk. There is some evidence that some lending institutions perceive organic farmers to be higher risk clients (Henning et al., 1990). On another level, however, it is exactly the opposite. It has been a common perception that fertilizers, pesticides, mechanization, and monoculture cropping represent the preferred practice for financial risk reduction, with the role of ecological diversity being largely ignored (Riccini and Brunt, 1987; Altieri, 1988; Rabbinge and Zadoks, 1989). The preferred practice is actually contributing to financial risk because of the side effects produced. Hodges and Schofield (1983) have reviewed the main negative environmental consequences of synthetic chemical use and monoculture cropping on the farm (Table 9). Such environmental side effects constitute direct costs to producers, on both a micro and a macro level. For example, declining animal health increases veterinary costs and can result in decreased yields of animal products. The erosion of plant genetic resources has more of a macro impact. The corn leaf blight scare of 1970 in the USA demonstrated how excessive national dependence on the same plant genetic material can threaten the security of individual farmers over a wide area (Doyle, 1985; Kloppenburg, 1988).

In fact, some investigators argue that the benefits of synthetic fertilizers and pesticides (the preferred practice) have been overestimated. For example, in Minnesota, Caldwell (1982:987) claimed that for corn production "... much of the gain attributed to commercial N-fertilizers has been a substitution for less animal and green manure, legume N and depleted soil organic matter". Applying Caldwell's analysis to other parts of the USA and Canada could lead to a serious reassessment of the relative risk-reducing power of these materials. Ironically, some programs that aim to reduce risk, such as crop insurance and income stabilization, have actually heightened risk by requiring "good management practices", which program staff interpret to imply high chemical input, low diversity cropping systems (Conservation Council of Ontario, 1986).

Product diversification as a strategy to reduce risk is being promoted again by many conventional producers and credit agencies (Agriculture Canada, 1983; Ehrenfeld, 1987; Hill, 1987), and some

bankers now feel safer lending to farmers with more than one commodity to sell (Giangrande, 1985). Organic farmers are in a better position to meet these conditions than conventional ones, since they already tend to be more diversified and ecologically adapted to withstand adverse climatic and edaphic conditions, and the financial risk associated with dependence on a single commodity (Culik et al., 1983; Gliessman, 1985; Helmers et al., 1986; Hanson et al., 1990)[(1)]. Risk reduction will become increasingly important because commodity prices could become more volatile for the next two or three decades (Wessel, 1983; Harrington and Edwards, 1988).

A further perceived risk is attributed to changes in marketing. Some growers, especially those wishing to sell organic produce, tend to rely more on direct marketing (Geier and Vogtmann, 1984; Cook, 1988; Peter and Ghesquière, 1988). Lenders may see such reliance as more risky, assuming that consumer preferences are sufficiently unstable to threaten the security of a grower's marketing system. Road-side stands and u-pick operations may appear to be most vulnerable to this kind of problem. However, there are aspects of consumer attitudes toward organic food that provide security for this marketing system. Regular buyers purchase organic food because they are concerned about their health and the environment (Watkins, 1983; Baseline Market Research, 1988), attitudes that reflect a more profound attraction to a product than brand loyalty. This suggests that consumers are likely to continue to buy from organic growers whom they trust. Growers can reinforce this tendency by direct contracting with a group of consumers in advance of the growing season. Such an approach is very popular in Japan (Réthoré and Robineau, 1988; Amano and Ichiraku, 1988), and is becoming more common in North America (Vandertuin, 1987; Van En, 1989).

Another potential source of concern for lenders is the apparent dependence by organic producers on premium prices, premiums they feel can not be sustained as production levels rise. It is not clear, however, that supply will catch up with demand in the near future, nor is it clear that those growers who are dependent at present on premiums for financial viability will remain so over the long term.

Consequently, the literature on risk in transition is confused by the limitations of current concepts of risk. More work needs to be done to isolate real risks associated with the transition from those risks determined by inappropriate measures.

2.6 Existing literature on widespread transition

Few studies have examined the implications of widespread adoption of sustainable agriculture. Most of these have focussed on transition to organic agriculture because it represents an identifiable point in the spectrum of sustainable approaches, particularly with respect to the identity of its products in the market.

A number of market commentators in North America and Europe feel that widespread adoption of organic agriculture is imminent. In Québec, the largest farm organization anticipates that over 40% of the producers in the province will be producing organically within 15 years (Hill, 1989). Growth rates for Canada as a whole are thought to be more modest, but are estimated to be 15-25% per year, reaching 2% of total retail food sales by 1998 (Christianson, 1988). In England, Holden and Seeger (cited in Patterson and Bufton, 1986) have estimated organic output at 20-25% of the total by 2010. A study of California organic products sold at the wholesale level has predicted a jump in sales from $68 million (1987, less than 1% of the market) to $300 million by 1992 (Franco, 1989).

The investigations attempting to analyse the impact of a major shift to organic/sustainable agriculture

have been methodologically controversial, underscoring the need for more study in this area (Youngberg and Buttel, 1984a; Lockeretz, 1989a; Madden and Dobbs, 1990). As indicated in section 1.5, existing studies have concluded that significant benefits would result from the shift, including improved food quality, enhanced environmental and human health, higher net farm income, and lower government subsidy payments and crop storage costs (Oelhaf, 1978; USDA, 1980; Langley et al., 1983; Vogtmann, 1984; Cacek and Langner, 1986; World Commission on Environment and Development, 1987; Havlicek and Edwards, 1989). The effect on consumer food prices has been projected to be minimal (1% increase in total food expenditures [Oelhaf, 1983]) or substantial (up to 99% increases in some commodities [Langley et al., 1983]). Prices would likely be affected regionally. In the USA, areas like Florida, which are more dependent on chemicals to produce fruits and vegetables, would likely lose production acreage, and prices could increase (Madden, 1988). Farm employment and farmer numbers could increase (Cornucopia Project, 1984; Enniss, 1985) and small- to medium-size farms could become more viable (Council on Agricultural Science and Technology, 1980; Madden, 1989). In some cases, where appropriate services, such as pest-control monitoring, are not available, and management and labour must increase, super-large farms could be at a disadvantage (Madden, 1988). Access to labour, particularly skilled labour will become an increasing concern as more conversions take place (USDA, 1980; Langley et al., 1983). Bellon and Tranchant (1981) fear that the aging farm population, in combination with the demand by young people for urban-style work conditions, could limit the number of farmers and farm labourers. Blake (1987), in contrast, points out that sustainable agriculture has some attractive work characteristics. He believes that relations with hired labour may be different than in conventional systems because the sustainable-agriculture philosophy stresses respect for all life forms, including fellow humans. In his opinion, these farmers may make greater efforts to provide employees with more educational opportunities and more challenging responsibilities.

Other potential difficulties associated with widespread transition include:

* Possibility of limited access to acceptable farm-scale sources of K for organic producers (Vogtmann et al., 1986). Efficient recycling of wastes and soil conservation are seen as long-term solutions.

* Limited physical and economic access to manure. Farms that do not produce their own manure will find supplies increasingly difficult to obtain as more farms convert (USDA, 1980; Vail and Rozyne, 1982; Langley et al., 1983). Dependence on imported manure is not, however, a long-term sustainable practice.

* Limited access to suitable equipment (e.g., tillage, manure, and slurry management), supplies (e.g., biocontrol agents), and services (e.g., pest monitoring, transition advice) may be limited.

* How would the transition affect and be affected by the tendency in land tenure toward increasing concentration of land within fewer hands and the loss of prime agricultural land to non-agricultural uses. The empirical evidence is contradictory (Batie, 1986; Boehlji, 1987; Duff et al., 1990), but it appears that operators of large farms, although in an economically superior transition position because of their access to resources (cf. Heffernan and Green, 1986), are generally less interested in the environment than owners of smaller farms (cf. Buttel et al., 1981). Farms on marginal land, however, are usually more difficult to convert than those on good land because of their more limiting physical and financial resources (Heffernan and Green, 1986). There is also considerable debate regarding the land base required, during and after widespread transition, to maintain acceptable production levels for domestic use and export. It is generally acknowledged that greater land area is required for diversified mixed

cropping/livestock operations, but how this translates to nation-wide land demands is not clear. Investigators in the USA (Oelhaf, 1983) and Europe (Elm Farm Research Centre, 1987) have suggested that land set-aside programs would be unnecessary after a widespread transition. An English report calculated that a 10% uptake of organic farming in Britain could cut total English cereal production by 20%, thereby achieving a major objective of set-aside programs, and would, as well, decrease dependence on imported grain legume protein (British Organic Farmers et al., 1989).

* Premium prices could decline in the long term as more organic food enters the marketplace (Duffy, 1987), yet this may not reduce net profits if input costs fall at the same time and as farmers become more competent at sustainable practices. As our understanding of agroecosystems increases, reliance on external inputs, and therefore operating costs, should decline. Oelhaf (1978), for example, estimated the cost of the transition period as 5-20% of food prices, a cost that would decline with more information and support from agricultural institutions. Even with a price depressing increase in the supply of organically produced food, consumer demand is growing, and this will moderate and could even offset the supply effect.

* The farm input industries, particularly fertilizer and pesticide manufacturing, will undoubtedly experience dislocations (Enniss, 1985). However, it is unlikely that these industries would be traumatized since transition will proceed incrementally, providing such industries time to rationalize or diversify their operations.

* Food export potential is likely to decline over time (Langley et al., 1983). This will cause economic dislocations because so much of the North American agricultural economy is geared to export. This reliance on export is, however, a central reason why agriculture is in so much trouble at the present time. For example, there is some evidence that recently grains have been exported from North America and Europe at a net loss to the countries involved (Brian Oleson, Canadian Wheat Board, Seminar at Macdonald College, Nov., 1987). In the long term, decreased dependence on export markets will benefit both developed and developing world producers (cf. Wessel, 1983).

Summary: implications for institutional activity

* Because transition is an evolutionary process, institutional initiatives must provide an on-going supportive environment that facilitates passage from one stage to the next (efficiency, substitution, redesign).

* Much of the literature on diffusion of information incorrectly assumes that economic factors are the primary motivation of farmers interested in any new approach (Heffernan, 1984; Duff et al., 1990). The selection and provision of supports for the research and diffusion process must take into account other motivational factors, such as environmental protection, health, and social justice.

* Up to now, farmers in transition obtain most of their information from both popular literature and other farmers. Consequently, the diffusion process should emphasize activities that bring farmers together, e.g., short courses, field days, the creation of on-farm research associations, and the establishment of networking newsletters.

* Farmers in transition tend to be more interested in systems of farming rather than in specific crops. Thus, the commodity-based orientation of many institutional activies may be a barrier to the transition.

* Changing the rotation often involves including crops for which the producer has no marketing experience.

* Careful planning of the transition is critical, and provision of technical assistance at an early stage can help to avoid many difficulties.

* Much of the success of the transition depends on access to locale-specific, rather than universally applicable information and solutions. Recommendations for research and for the training of farmers and extension agents should reflect this reality.

* The transition period involves financial risks, although these may be overstated by agricultural institutions. The economic transition process may be twice as long as biological transition (Hanson et al., 1990). Farmers with no financial flexibility cannot realistically attempt to convert without substantial financial assistance (Hanley, 1980; Aubert, 1982; Vogtmann et al., 1986).

* Insufficient research is being undertaken on the transition process, on both micro and macro levels.

1. In a notable exception, Stanhill (1990) has concluded from his analysis of a number of yield studies, that organic farming systems demonstrate no "weatherproofing" effect.

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5.0 Discussion

The purpose of this chapter is to further explore the ideas presented in the Results Section and to weave the data from that section into a narrative that more clearly expresses the results of the study. The general theory is used to organize and present the data. This provides the reader a better opportunity to examine the conceptual coherence of the general theory. The narrative is divided into the three institutional areas, although there is overlap in certain subsections.

5.1 Governmental and para-governmental institutions

The discussion in this section concentrates on four different aspects of the transition. In Table 47, efficiency, substitution, and redesign concepts were applied in general terms to the process of making decisions, and to the content of the decisions. The deficiencies of government management procedures (and of public administration generally), and efficiency and substition solutions, have been discussed extensively (cf. Jackson and Atkinson, 1980; Forbes, 1985; Beaubien, 1986; Pross, 1986; Skogstad, 1987; Jabes and Zussman, 1988; Jackson, 1988; Plumptre, 1988; Osbaldeston, 1989; Zussman and Jabes, 1990). The emphasis here is on efficiency, substitution and redesign of the content of decisions, and on the redesign of the organizational process, as these areas have received less attention. Note that the research and research funding activities of government will be discussed in Section 5.2.

5.1.1 Efficiency-stage strategies: removing primary restraining forces

5.1.1.1 Policies and programs that limit diversification

A number of federal and provincial government agronomic and marketing programs and policies have been implicated as impediments to the diversification of farming systems(1) (Table 49). The OECD (1988) has stated that removing constraints to diversification should be a primary strategy for solving agricultural problems.

A number of these impediments will probably be hard to remove because their precise effects are difficult to identify. In the absence of concrete evidence, decision makers have tended not to act

(Pidgeon, 1984; Manning, 1988), especially when no politically viable direction is apparent. The Western Grain Transportation Act (WGTA) and the Feed Freight Assistance Program are good examples of policies in this category (Pidgeon, 1984; Senate of Canada, 1984; Gilson, 1987).

Other barriers may be easier to weaken or remove. For example, crop insurance programs could encourage diversification by broadening the concept of good management to include environmentally-sound practices (Conservation Council of Ontario, 1986). In many instances, a farmer who does not use pesticides and fertilizers is regarded as a poor manager and is denied coverage. Pidgeon (1984) has recommended that prairie crop insurance benefits be increased for specialty crops that conserve soil. The Canada-Saskatchewan Crop Insurance Program has effectively set up such a program targeted at organic producers. The program has set prices for organic cereals at 3.5 cents / pound higher than prices for non-organic, Wheat Board grains. For non-Board grains, the market price has been set at 20% above conventional (Braidek, 1990). The longer-term need is to design crop insurance programs for farming systems, not just for specific crops(2) .

The Federal Fertilizer Act could be modified to allow for easier registration of organic fertilizers. Presently, the regulations require that a precise minimum formulation for macronutrients be consistently present. For biological materials and natural rock powders such guaranteed analyses are difficult to achieve consistently, and the importance of other aspects of these materials is ignored. Many sustainable agriculture proponents feel that the Act is well administered, but that its terms of reference are inappropriate. The Act is designed more to prevent fraud than to support specific agronomic practices. The absence of alternative products in the marketplace can make transition to organic farming more difficult. Modifying the terms of reference for the Act does not eliminate the need for more research on alternative fertilizers to identify their usefulness.

The impact of inappropriate government programs is cumulative. Because most restrain diversification by focusing on the production of specific crops, more attention is paid to the commodity lobby, and correspondingly, the pressure for specific commodity interventions increases at the expense of policy options proposed by organizations addressing production- neutral strategies (including those within a systems orientation) (Economic Council of Canada, 1988). Coffin (1988) has observed that commodity groups have increased in political strength at the expense of general farm organizations.

5.1.1.2 Programs that specifically restrain sustainable agriculture

A number of specific programs, regulations and operating practices appear to create difficulties for entering or practicing organic farmers (Table 50). These either encourage incompatible production practices or limit the ability of producers to market their products as organically produced. Many of these barriers can be attributed to institutional ignorance. They may be overcome if these institutions hire professionals who understand organic farming practices, or if they retrain current staff. For example, credit agency staff who understand sustainable production practices, and have access to appropriate data appear to have a good appreciation of the credit worthiness of organic producers (Henning et al., 1990).

Few marketing channels have been established for the products of sustainable practices, and producers of such products generally have little access to the decision making structures within existing marketing boards. Recent events suggest, however, that some progress is being made. The decision by the Canadian Egg Marketing Agency to permit an organic grower to market organic eggs without quota may be the beginning of a necessary re-evaluation by the marketing boards (Anon., 1989a). The board was

persuaded that organic eggs were a specialty item that would not compete with their regular product. This suggests, however, that as production of organic eggs increases, the board will have to develop a more comprehensive response. Organic milk is now available in Québec, and a number of Ontario organic milk producers have had preliminary discussions with dairies. The main obstacle to processing and marketing organic milk in Quebec was not supply[(3)] , but rather obtaining government and marketing board approval (J. Boutet, Mouvement pour l'agriculture biologique, pers. comm., Sept. 1989). The Canadian Wheat Board is now assisting organic grain producers with exports (Crowley, 1990). Growing government interest in the regulation and marketing of organic foods (MAPAQ, 1989; Ad hoc Committee on Organic and Natural Foods, 1990) has likely been a factor in encouraging the boards to work with organic producers and processors. If this trend continues it would parallel European developments where several governments have established organic product marketing within existing services (Peter and Ghesquière, 1988).

Other changes may come more slowly. Marketing boards may have to make new investments, or require businesses dealing with them to do so. For example, some Ontario communities have only one bin for collecting grain, resulting in the mixing of organically-grown grain with conventionally-produced grains (Robert Mouck, organic grain grower, pers. comm., April, 1988). The boards may also be reluctant to exempt organic producers from paying charges for services they do not use.

5.1.2 Substitution-stage strategies: supporting driving forces[(4)]

5.1.2.1 Training

5.1.2.1.1 Agroecology training programs and seminar series for staff scientists, economists, and credit agency staff

Within the federal government, training programs on a variety of subjects are offered on a regular basis (language, management, environmental impact assessment, etc.). Seminars on agroecology have already been given and a structure already exists for presenting agroecology short courses. Provincially, the Alberta Department of Agriculture has been running workshops for agricultural lenders that could act as a model for agroecology training for credit agency staff. Such training courses could also include tours of sustainable farms. A regular seminar series on agroecological topics would also facilitate scientific and economic appreciation of sustainable agriculture.

5.1.2.1.2 Training programs for extension personnel

The federal government should facilitate the work of provincial departments of agriculture in setting up training programs for extension personnel. The Québec department of agriculture started offering courses in the winter of 1989. The Ontario Ministry of Agriculture and Food (OMAF) has sponsored some conferences and seminars on sustainable agriculture. The PEI department of agriculture has organized seminars, workshops, and farm tours for its extension staff. Using these experiences, federal staff could work with counterparts in other provinces to establish training protocols and curricula to encourage consistency of programs across the country. One possible forum for discussing this is the meeting of the ministers of agriculture. Of particular importance is the development of competence in helping farmers develop transition farm plans.

Most provinces have extension staff responsible for farmers using sustainable practices. Extension networks are well developed and state-financed in a number of European countries (Peter and Ghesquière, 1988; Young and Schwenk, 1989).

5.1.2.1.3 Training programs for farmers

The most successful farmer training in sustainable agriculture is being carried out by private associations such as the Ecological Farmers Association of Ontario, Canadian Organic Growers, le Centre de développement d'agrobiologie du Québec, the Similkameen-Okanagan Organic Producers Association, and Sustainable Agriculture for the Valley Ecosystem (SAVE) -- New Brunswick. These associations have used a mix of training strategies, including conferences, farm tours, demonstration days, workshops, and videos. Some have received irregular financial support from a variety of government agencies including Agriculture Canada, provincial departments of agriculture, departments of education (in Québec through the adult education services), and Employment and Immigration (retraining programs). The critical limiting factors for these kinds of programs (as identified in communication with the associations) are:

a) lack of a sufficient number of qualified trainers to meet the demand for training courses. Some associations have proposed that standards for training trainers be developed, and that government assistance be provided for running the training programs.

b) insufficient technical and financial assistance for developing transition training materials, such as manuals and videos.

c) lack of farmer subsidies to cover tuition, travel and time to permit their participation in longer courses. A number of jurisdictions in Europe offer such support. The state of Saarland, West Germany, provides small loans to converting farmers in the form of a replacement salary while the farmer is away on a week-long training program (300 DM -- ~$180 Cdn), and tuition fees (200 DM -- ~$120 Cdn) (Peter and Ghesquière, 1988). An OMAF training program concerned with farm management and conservation (cf. Ontario Ministry of Agriculture and Food, 1987, 1988) permits courses offered by the Ecological Farmers Association of Ontario to be covered (Lawrence Andres, President, EFAO, pers. comm., Nov. 1988).

One possible model to explore is that used by a number of international development education agencies. In exchange for financial assistance, participants in programs agree to be involved in training others. Farmers who receive assistance could contract with the program organizers for a certain number of demonstration days or workshops with other farmers interested in undertaking a transition.

5.1.2.1.4 Newsletter / bulletin

A number of private organizations publish bulletins, outlining the latest developments in sustainable agriculture in the field. Such bulletins provide an extremely useful service to the private sector. They are not as good at keeping abreast of institutional developments because most have neither the contacts nor the resources to follow institutional activities. A bulletin describing such initiatives as research projects, policy and program committees and developments, provincial undertakings, opportunities for private sector input into government discussions, and funding programs for private sector projects, would fill a large information void.

5.1.2.2 Marketing and quality control

At this time, the most visible products of sustainable agriculture are organically-grown and raised foods.

This is largely because the term organic has some meaning in the market place (although consumer confusion does remain [cf. Baseline Market Research, 1988]), and because organic production practices have been described in a manner acceptable to the market place. Consequently, this section concentrates on this sector. The market for organic foods is dynamic, with emerging opportunities and challenges. It exists, however, in a state of disequilibrium and inefficiency (Hall et al., 1989), which can be reduced by policy interventions.

5.1.2.2.1 Support for certification

Since the early 1980s, non-governmental agencies in North America have been certifying organically-grown foods from farms practicing sustainable agriculture. There are no national estimates yet of what percentage of production from sustainable practices is marketed in this way, but in Québec, the figure is estimated at 30%.

Use of the label "certified organic" developed as a way to assure consumers that the food they are eating is, in fact, grown according to the practices that are commonly associated with the word "organic". Those involved in promoting "organic" food were aware of what had happened to the "natural" food market. Because "natural" was not clearly described and protected, it was easy for the word to be coopted and used to describe almost any kind of food product or process.

The certification process is useful in our food economy because consumers usually do not know the farmer whose products they are buying. Many organic growers are involved in interprovincial and international trade. In some countries, such as Japan, certification has not been as important a development. The Japanese sustainable agriculture movement has instead focused on bringing consumers and producers closer together by creating consumer-producer cooperatives and buying groups, thereby reducing the need for certification (Amano and Ichiraku, 1988; Réthoré and Robineau, 1988). In this kind of system, consumers may even be involved in farm management decisions. This approach is also being practiced in a few places in North America (Vandertuin, 1987; Van En, 1989).

Certification is being undertaken by private agencies in all provinces in Canada. The certification standards all have a common base but often differ in details, depending on the ecological and economic conditions that exist in the region. Although based on "agroecological" principles, each set of standards is in fact a compromise between the ideal situation and the state of development of sustainable practices in each region. For example, in some standards, certain fertilizers and pesticides are permitted, even though they may have detrimental effects on beneficial soil organisms, natural pest control agents and wildlife (for a general discussion of the problems of synthetic fertilizers and pesticides, see Appendix 11). In many cases, our understanding of the ecology of a pest or production system has not yet advanced to the point where we can assure a productive and profitable system without using such products over the short term. The diversity within the sustainable agriculture movement also means that each set of standards is a compromise between the different schools of thought.

Certification agencies have had success ensuring that those in their program comply with the established standards. Verification procedures include on-site inspections, paper audit trails, and independent third party review of applications. Agencies have, however, no resources to verify those who claim to be producing organically but have not participated in a recognized certification program. This deficiency in the certification process is widely perceived by farmers to be a major impediment to expansion of organic farming (cf. Cook, 1988; Henning et al., 1990).

A number of US states have responded to this concern by either taking on the certification themselves (e.g., Texas, Washington, New Hampshire, Colorado, Oklahoma) or by providing regulatory and financial support to non-governmental agencies (12 other states including Minnesota, Ohio, California) (Center for Science in the Public Interest (CSPI), 1989; Poncavage, 1989). Typically, the regulatory support has involved legislating a definition and minimum production and processing standards. British Columbia passed the "Food Choice and Disclosure Act" in the summer of 1989, a bill to enable the regulation of the term organic and other alternative production systems. Québec and Manitoba Departments of Agriculture have been discussing with certification agencies the possible framework for regulatory support. At the federal level, Consumer and Corporate Affairs has accepted a definition of organic food written by the organic foods industry. This definition is presently only enforceable under the general provisions of section 5 of the Food and Drug Act and section 7 of the Consumer Packaging and Labelling Act respecting misleading and deceptive representation of food (Consumer and Corporate Affairs, 1988). However, until the consumer perception of organic food has become clearer, the department is unlikely to enforce the definition even under these provisions (Charles Sheppard, Consumer and Corporate Affairs, pers. comm., April, 1989). A sub-committee of the Canadian Agricultural Research Council (CARC) is presently developing recommendations for the federal government on how it can support the process of certifying organic products (Ad hoc Committee on Natural and Organic Foods, 1990). The committee's perception is that the federal government will have to act in order to coordinate provincial initiatives, to reassure consumers, and ensure access to international markets. This latter concern could be particularly important as international trade in organic foods is rapidly increasing (International Federation of Organic Agriculture Movements, 1989). Concurrent to this growth is the development of regulations in the European Economic Community and in the USA that, in the present environment, could prevent the sale of Canadian organic produce in these jurisdictions. Some are of the view that the EEC is quick to take advantage of possible barriers to trade of Canadian goods (Hooper, 1989). The OECD (1988) has called for international certification standards to avoid trade problems in organic food.

5.1.2.2.2 Support for direct and local marketing

For some years now, municipal and provincial governments have been supporting certain forms of direct marketing and local purchase. Few of these supports, however, have been designed specifically to promote sustainable agriculture and its products. The state of Texas has initiated a promotion of Texas organic food to complement their existing Taste of Texas promotion. The Department of Agriculture has also been providing technical and financial support to farmers markets, cooperatives and the development of local processing facilities, all part of their initiative to localize the food system (DeMarco, 1987). These programs have been developed during a period of budget cutbacks and elimination of programs that were thought to duplicate those of other departments (John Vlcek, Assistant Director of Marketing, pers. comm., July, 1988). Departments of agriculture in New York and Vermont have given grants to organic farmers to create marketing cooperatives (Center for Science in the Public Interest, 1989). Many states already have elements of these programs (cf. Belden et al., 1980) and many Canadian provinces and municipalities have provided limited support for farmers markets. New Brunswick, for example, announced in 1988 a program valued at $86000 to encourage farmers' markets in the province (Agriculture Canada, 1989b). This kind of initiative could be easily modified to encourage organic production.

5.1.2.2.3 Institutional purchase

Institutional purchase of organic food (or of any other products of sustainable practices that can be clearly differentiated in the marketplace) gives organic food a certain respectability and sets in motion a chain of events that ultimately leads to greater production levels. A number of USA states have used legislation on institutional purchase to encourage the production of locally-grown foods (Hyde and Kennedy, 1981) as have municipalities (Vail et al. 1985). The Québec government has instituted a similar program for school purchase of locally-grown foods (Linteau, 1988). These buy local programs can be modified to include purchase of organic and other foods produced from sustainable practices. The British Parliamentary restaurant, a high profile institution, is now ordering organic food (Anon., 1988), as are hospitals in some Swedish provinces (Rundgren, 1989).

5.1.2.2.4 Market research

Demand is strong for certain products of sustainable systems in some regions of the country. A recent study, funded by Agriculture Canada, identified strong demand for organic fruits and vegetables in urban centres across the country (Baseline Market Research, 1988). This strong demand has made marketing easier for these products. Demand for other organic, and for other sustainable agriculture, products has not been as strong, and producers have not had the resources to identify where the demand is, or how it could be strengthened (consumer awareness, clearly identified products, etc.). A comprehensive program of market research with the following elements would greatly improve the market information base.

a) Priority products: research should focus on organic meats, eggs and feedgrains, and on transitional products, including those grown under low-spray and reduced synthetic fertilizer conditions(5).

b) Price: some crops from sustainable agriculture operations sell at prices considerably above present prices. Research to identify the price that the various target markets are willing to pay for different fresh and processed products can facilitate development of new markets. Possible target markets include coops and pre-order groups; farmers' markets and pick-your-own; health food stores; day care centres; hospitals and other health care institutions; public schools, colleges and universities; produce stores; gourmet and specialty shops; restaurants; convenience stores; and supermarkets (Christianson, 1988). New Hampshire publishes organic food prices in its marketing bulletin (Frisch, 1989). California has provided financial support to the Organic Market News and Information Service (OMNIS), which publishes a weekly price bulletin and disseminates supply and price data to analysts (Franco, 1989).

c) Promotion: although the context for food promotion in sustainable agriculture differs from that of our present system (see Section 5.1.3.2.2), promotional strategies are still necessary. What kinds of presentation (food and packaging) are attractive to existing and potential buyers? What colors are appealing? What kinds of labels or symbols are viable? What are the characteristics of sustainable food production that appeal to purchasers? What are the most relevant advertising tools?

d) Place: because local production and distribution systems are essential to sustainable agriculture, special attention needs to be paid to opportunities for local distribution. This is especially so for regions in which local demand appears to be weak (e.g., fruits and vegetables in the Prairies, meat in the Maritimes).

5.1.2.2.5 Improving consumer information

Market inefficiencies are partly caused by insufficient consumer information (Hall et al., 1989). Public demands for information on food production and handling practices, particularly among allergy sufferers,

is on the increase. The food industry has exerted considerable influence on decision makers' perceptions of this issue (Hall, 1974; Warnock, 1978; Pim, 1986), thereby limiting consumer access to information. The process of certifying organic food is one way of permitting consumers to obtain full information on the practices involved in food production, processing and distribution, particularly because it discloses more about the practices involved than government regulations require (Thériault, 1988). For example, the Health Inspection and Grade Stamps indicate that a product has been visually inspected for grading and "wholesomeness", but tells the customer little about the production process.

Some progress on increasing consumer information, using penalties, is being made in the USA, particularly in California as a result of the controversial Proposition 65, the "Safe Drinking Water and Toxic Enforcement Act". This act requires that companies with more than 10 employees warn citizens if they are exposed to significant levels of chemicals causing cancer or birth defects. At the beginning, 29 chemicals were covered by the law, but the list had grown to 296 by July, 1989 (Phipps et al., 1989). Food, drugs and cosmetics that are regulated by the USA Food and Drug Administration have been exempted from warning requirements. The California government is also permitting food companies to use toll-free numbers in stores rather than providing shelf and label warnings. These provisions essentially gut the initiative and have been challenged in court by proposition proponents (Kramer and van Ravenswaay, 1989; Phipps et al., 1989). As of spring 1988, similar proposals had been introduced in 20 other states. In Canada, such a process would have to be initiated by a provincial or the federal government because the proposition system is weaker in Canada, existing only in some municipalities. The Workplace Hazards Materials Information System (WHMIS), however, might provide a framework for such regulations. The system is a result of amendments to the Hazardous Products Act and The Canada Labour Code at the federal level and amendments to each province's Occupational Health and Safety Act. At this point the system only applies to workers in the workplace. Substantial changes to the context and content of the amendments will be required, however, to produce Proposition 65-type legislation.

Maine recently passed two bills to provide consumers with more information on contaminants in food. One requires country of origin labelling for imports from countries using pesticides banned in the USA and sets up an in-store education program for consumers on the implications. The second bill requires retail outlets to post a conspicuous sign informing consumers that suspect post-harvest treatments (Benomyl, Biphenyl, CIPC, Captan and others) have been used on the food (Anon., 1989d).

5.1.2.3 Safety net and production incentive programs

5.1.2.3.1 Crop insurance

The efficiency approach, discussed above, involves modifying the definition of good management and the fee structure to permit premium payments for those who are able to sell their products at higher prices. A substitution strategy involves designing a distinct crop insurance program to support farmers in transition, as has been done on a pilot scale by the PEI Department of Agriculture. The department underwrites 50% of any yield reduction associated with the transition, up to a maximum of $5000 per cooperator/year. During the trial period, this assistance has been restricted to coverage on 20 acres or 10% of the total farm acreage, whichever is less (PEI Department of Agriculture, 1988). The state of Saarland, West Germany offers compensation payments for any lost income during the conversion period (up to 5000 DM ($3000 Cdn) depending on family status and year of the conversion) (Peter and Ghesquière, 1988).

Another possibility is being considered by the USA Congress. The 1990 Farm Bill could contain a provision for rotation and IPM crop insurance (Benbrook, 1988). This is not as desirable because it diminishes the systems focus of crop insurance programs. See Appendix 12 for a fuller discussion of the limitations of the approaches taken in the 1985 Farm Bill and those proposed for the 1990 Bill.

5.1.2.3.2 Credit assistance

Governments in Canada have traditionally supplied credit assistance to farmers through guarantees and interest rate subsidies (Canadian Federation of Agriculture, 1983). Credit policy is a powerful tool (Office of Technology Assessment, 1986) that can and has been used to shape agricultural structure and practice, and that could be used to promote sustainable agriculture. Different kinds of assistance programs could be provided through the Farm Credit Corporation (FCC). FCC and government programs have effectively provided services that commercial lenders could or would not provide, and have stimulated, at times, the development of certain commodities (Agriculture Canada, 1983)(6).

The states of Texas, Iowa, Kentucky, Missouri, Nebraska have developed a "Linked Deposit Program" to promote the diversification of agricultural production and processing in the state (DeMarco, 1989). In Texas, state treasury deposits are made available through all 1600 state-approved financial institutions at lower interest rates. Producers following sustainable agricultural practices are one of the targeted groups for the program. Approximately US$2 million has been used so far in the program, a sum that has attracted over $3 million in additional private investment (Reynolds, 1988a,b). With financing comes technical assistance. Minnesota has developed a credit program specifically for organic farmers.

The province of Québec's "An Act Respecting Farm Finance" (Québec Official Publisher, 1987) contains a section (Section 3 -- Special Loans) that might be an appropriate vehicle to provide this kind of credit assistance. It provides for credit and a subsidy to producers who need to convert their production system because of severe economic dislocations. Of particular interest is the provision to loan sufficient funds for conversion and living expenses (subject to a maximum) until alternative production is suitably established. Modifications to this act could easily be made to include farmers converting to sustainable practices.

5.1.2.3.3 Production subsidies

In concert with credit policy, production subsidies have been used to encourage production of particular commodities. Some analysts propose that a similar approach be used to encourage sustainable agriculture with one major conceptual difference. Supporters advocate that the subsidies be designed to support systems rather than specific commodities, and to incorporate externalities, something that would be a substantial departure from previous practice (Daberkow and Reichelderfer, 1988). Others have recommended providing subsidies for specific kinds of capital equipment to facilitate the development of more ecological systems. For example, Bateman and Lampkin (1986) have suggested that during the transition period subsidies should be provided for capital-equipment investments, such as waste-handling systems, to facilitate the development of on-farm fertilization programs(7). A possible variation on this theme is subsidizing the purchase of equipment by farmer organizations or cooperatives that loan equipment to transitional farmers. This cuts down on the potential costs of experimenting with different kinds of equipment while searching for the most appropriate option (D. Lafrance, Centre de développement d'agrobiologie du Québec, pers. comm., Sept. 1989).

Denmark, Sweden and several German states have developed different kinds of programs. The Danish government has chosen to subsidize converting farmers at about $430/ha (payments over a three-year period) as part of a 10-year program to help convert 10% of the country's agricultural land to organic farming. They also offer development grants to converting farmers and are contributing several million dollars to certification organizations to assist their efforts. This strategy is, however, controversial. Some believe that this level of subsidy/ha, given the Danish agricultural economy, is insufficient to encourage farmers to convert and propose that it be increased to at least $660/ha (Stopes and Woodward, 1988). Others are afraid that any level of subsidy penalizes those who have already converted, and may flood the market place with organic food, thereby eliminating the organic premium(8) (British Organic Farmers and Organic Growers Association, 1988). Some analysts propose that those farmers who have already converted receive the same level of support as those converting in order to address the equity question (Midmore and Lampkin, 1988). Sweden has developed a program of this nature (Rundgren, 1989).

Subsidies of this type are not without problems of potential greater importance. The benefits have traditionally favoured the larger-scale operations, often to the detriment of the smaller ones (cf. Rodefield et al., 1978; Troughton, 1985; Heffernan, 1986; Strange, 1988a). Furthermore, the practices that the subsidies have been designed to encourage may be abandoned after the subsidy is removed (Swanson et al., 1986). European policy analysts have hoped to avoid this situation by requiring that eligible farmers belong to a certification agency. Then if the practices are abandoned, the certification label is withdrawn, and an economic penalty results.

One other interesting subsidy approach being practiced in Germany is payment for ecological management of non-productive areas of the farm that produce favourable ecological and economic benefits for the whole farm environment. In one program, farmers are paid to leave field borders unsprayed to encourage native flora and fauna and encourage biocontrol agents (Ahrens, 1987; OECD, 1988).

A moderate level of subsidy, then, may be a successful part of a package of policy initiatives for the transition period if both the content and process of subsidy administration are changed. Alternatives to the methodologies for developing eligibility and for evaluating costs and benefits are required. To avoid committing large amounts of human and financial resources for budgeting and administration, such subsidies could be included in an existing program, such as Ontario's Land Stewardship Program. The number of farmers who might participate in such programs is unclear. One indication is provided by a recent survey carried out for the American Soybean Association (1989). When asked how they felt about a farm program requiring reductions in crop chemical use, 60% of farmers were opposed, 25% in favour. When payments were added to support farmers making reductions, opposition fell to 41% of respondents. These results suggest that a number of farmers would be positively influenced by the presence of financial supports.

5.1.2.3.4 Tax provisions

Taxation policy has long been recognized as a major cause of our present agriculture problems. Provisions that encourage the substitution of land and capital for labour have been particularly criticized (Rodefield et al., 1978; Flinn and Buttel, 1980; Youngberg and Buttel, 1984b; Troughton, 1985; Strange, 1988a). For example, Accelerated Capital Cost Allowance provisions have been identified as penalizing those who wish to follow a lower capital intensity approach.

As a preliminary step toward identifying potential tax changes, there is a need for a comprehensive review, of this kind recently undertaken in the USA by the Natural Resources Defence Council (Ward et al., 1989), of how the Canadian tax code discourages sustainable practices. According to the report, the 1986 Tax Reforms in the USA reflected the need to protect the environment by changing tax provisions, an orientation that has been missing from Canadian tax law changes. The 1986 Act removed: a) many of the benefits of tax shelter investing in agriculture; b) the biases to overproduction, including capital investment incentives, preferential treatment of capital gains; and c) incentives for bringing marginal land into production(9). In their assessment of changes that still have to be made, the NRDC identified the following areas: a) cash accounting contributing to excessive expenditure on input supplies; b) ACCA contributing to the breaking of marginal land; c) fertilizer and lime deductions encouraging applications in excess of those necessary for sustainable crop yields. The NRDC proposed changes to moderate the negative consequences of these provisions without unduly penalizing farmers or creating unnecessarily large administrations. These kinds of changes remove some of the forces restraining the development of sustainable practices.

Taxation penalties and rewards can also be developed. The application of a pollution tax to synthetic fertilizers and pesticides has been proposed by a number of analysts to make agricultural chemicals better reflect their social and environmental costs (Costanza, 1987; Fleming, 1987; Postel, 1987; Weinschenk, 1987). Some have proposed low tax levels (around 1%) to generate funds for monitoring pollution and for conducting research on alternatives (Fleming, 1987; Postel, 1987; Ward et al., 1989). This approach may have some appeal to policy makers because costs are low, money is raised for other budget areas(10), and consumption is not restricted so much that the chemical lobby would be very actively opposed. It does not, however, reflect the polluter pays principle to which some jurisdictions have committed themselves. Also, this level of tax is not likely to reduce pollution in the short term (Daberkow and Reichelderfer, 1988; OECD, 1988).

A higher tax level would have a greater allocative impact. Weinschenck (1987:58) has stated that a nitrogen tax should "...induce changes in the farm organization... (including) better and more careful use of organic fertilizer (and) diversification of the crop rotation.". Such a tax, however, could require more administrative inputs, could result in higher consumer prices, and would raise a psychological barrier for policy makers, i.e., promoting an explicit policy of production reduction in some major farm commodities. Koopmans (1987) modelled the potential effect in Europe of a 50% tax on nitrogen, phosphorus and potassium over a 20-year period. He predicted major reductions in wheat and rice outputs, a decline in fertilizer use of 27%, and greater than 20% reduction in fertilizer delivery to the environment. Even with these reductions he concluded that these "...measures to protect and improve the environment are not necessarily at variance with economic objectives, particularly farm incomes." (p. 158). Land and product prices would rise substantially, however. Other German data suggests that a fertilizer tax of 200% would reduce use by 30%, farm income by 25% and water pollution by 50%. Farmers would, in response, place more N-fixing crops in their rotations. A similar rate of tax on pesticides would reduce consumption to just 18% of current levels (OECD, 1988). As both the manufacturers and the farmers need to take responsibility for the environmental damages of pesticides (others are also responsible for pesticide use of course, but difficult to cover by a tax), the tax rate needs to be high enough that consumption is substantially reduced and companies financially penalized. Maass (1989) has calculated that a tax rate of 35% will cover many of the external costs of synthetic chemical use. A general problem with input taxes is that non-polluting users are as affected as polluters (OECD, 1988).

Pollution taxes on agricultural chemicals have been implemented in a number of jurisdictions in the USA and Europe and are under consideration elsewhere (Postel, 1987; OECD, 1988; Benbrook, 1989)(11). Most of the jurisdictions using them have more acute environmental problems associated with agricultural chemicals than does Canada at the present time. Given some of the effects of their use on consumption and food prices, decision makers' interest in penalties of this kind may only be triggered by high levels of contamination and a massive lobbying effort by environmental groups. As this example demonstrates, penalties will cause some groups in the food system to suffer and their political power may be sufficient to discourage governments from applying them. Clearly pollution taxes are controversial, with winners and losers. My view is that they should be used as complements to other initiatives that address the design of agroecosystems (as opposed to the use of agrochemical and curative solutions).

Following similar thinking, Goldsmith (1988) proposed a number of other taxes: i) a raw materials tax, proportionate to the availability of the resource, to lengthen its period of use, but making it sufficiently expensive that our dependence on it would diminish; ii) an amortization tax proportionate to the estimated life of the product -- a 100% tax for a product designed to last less than a year, no tax for something designed to last 100 years (not all goods would be affected by this of course, including food and some hygiene products); iii) a transport tax to encourage use of local products.

On the reward side, the Rhode Island Division of Agriculture and Marketing is considering a proposal to eliminate property taxes for farmers following recognized sustainable practices (Frisch, 1989). Many Canadian provinces already have property tax rebates that could be used to encourage sustainable approaches (Conservation Council of Ontario, 1986).

5.1.2.3.5 Land use regulations

A related strategy, also a penalty approach, is to regulate the practices that are permitted on the land as a means of promoting different land use practices and patterns. This approach is being used in Europe to combat particularly severe pollution problems. Denmark requires the planting of autumn catch crops to reduce nitrate pollution. The Netherlands taxes excessive manure spreading. Both nations require that fertilizer management plans be developed and approved (OECD, 1988). The UK has identified nitrate sensitive zones in which certain practices are forbidden (Woodward, 1990). Nebraska authorizes districts to control the timing and rate of N applications (Benbrook, 1989). These strategies may cause farmers to adopt more diversified cropping systems as compensation for the loss or restriction of agrochemical use. Organic farming organizations in the UK are lobbying hard to have organic practices recognized as viable solutions for problems within restricted zones (Woodward, 1990). Other strategies for changing land use patterns are provided in Section 5.1.3.3.2.

5.1.3 Getting to redesign

The above strategies support incremental change towards sustainable agriculture. They only partly address, however, the sources of our agricultural problems and the institutional structures and processes required to support a comprehensive transition. What is required is an extensive redesign of institutional form, processes and interventions to reflect ecological laws and food system goals, and to implement strategies to create a truly sustainable agricultural system. The intent in discussing redesign strategies is not to be conclusive, but to identify some of the issues and present some potential solutions that must be considered. Many important conceptual questions regarding the development of sustainable agriculture are not being asked by agricultural professionals (Lockeretz, 1988).

The ecological principles outlined in previous sections provide a foundation for developing new goals for our food and agriculture system. Deficiencies in our political process have meant, however, that no mechanism exists for a far-ranging and participatory discussion of goals for a sustainable system. A preliminary list of such goals and their relationship to ecological principles is provided in Table 51. The critical challenge is to refine them, reconcile their contradictions, evaluate their implications and to adopt appropriate action plans. Some of their implications are examined below. A detailed discussion of specific objectives that are consistent with these goals is beyond the scope of this thesis, but some preliminary thinking on some possible medium-term specific objectives are presented in Appendix 13.

5.1.3.1 Changing the role of the state in agricultural development

The federal government has primarily used agriculture as a tool to achieve other objectives. The government's interpretation of national economic needs has been a prominent determinant of their approach to agricultural development (cf. Veeman and Veeman, 1976; Warnock, 1984; Forbes, 1985; Skogstad, 1987). This is consistent with the historic role of the state in Western democracies. Early Western European governments occupied themselves primarily with regulating trade and commerce and, although the activities of the state have diversified considerably, most still see management of the economy as their paramount function, and pursue other initiatives in light of their impact on it (cf. Bookchin, 1989). This role for the state is now widely perceived to be inappropriate, although few countries have made significant progress towards addressing these deficiencies. The main problems include:

1) The economy that the state addresses and attempts to measure and manage encompasses only a small part of human economic activity. The primary focus has rested on the workings of the market, but much economic activity is not part of the market place (Henderson, 1981; Ekins, 1986a). In agriculture, such things as beneficial soil organisms and insectivores birds can not be directly bought and sold in the market place; they do, however, play a critical role in sustaining agriculture. More broadly put, it is evident that the principles or "laws" of the marketplace do not correspond to the "laws" of ecology. This so-called "market failure" has been addressed in detail by a number of economists (Georgescu-Röegen, 1971; Schumacher, 1973; Daly, 1977; Henderson, 1981; Robertson, 1983; Ekins, 1986a; Martinez-Allier, 1987) Although this will not be discussed further here, it is important to note that the concept of redesign does not imply on the one hand, a total rejection of neo-classical economics, nor, on the other hand, a state-controlled market economy. It does mean, however, that for redesign to be successfully applied in agriculture, a parallel process of redesign is required in the discipline of economics. As this process is underway (cf. Costanza, 1989; Batie, 1989), it is difficult to speculate on the outcome, but it is likely that a much more comprehensive means of accounting for the costs and benefits of different human activities will be the result. Such changes can only help to make many of the strategies presented in this paper more economically viable.

2) The main beneficiaries of state intervention have historically been a ruling elite (cf. Buttel and Newby, 1980; Bonanno, 1987). Although the nature of this elite has changed over the centuries, some argue that the Canadian state still primarily benefits only a small economic class (cf. Panitch, 1977; Newman, 1979; Francis, 1986). The agricultural processing, manufacturing and distribution sectors, in particular, are dominated by small numbers of vertically and horizontally integrated firms controlled by a small number of families (Mitchell, 1975; Francis, 1986; Coffin, 1987; Winson, 1988; Kneen, 1990).

3) Most individuals do not participate in the political decisions that affect their lives. An Ontario study found that less than 15% of the population were involved in election activities beyond voting and posting lawn signs (cited in Ontario Public Interest Research Group, 1984). The percentage of people involved in pressure groups and political associations is even smaller (cf. Pross, 1986). Indeed, our Western democratic political process is not based on the premise of full participation (Barber, 1984). This deficiency has profound implications for our food and agriculture system because 1 in 6 Canadians are dependent on this sector for their employment, and we all have to eat.

A discussion of how our political process should be redesigned to reduce these problems is beyond the scope of this thesis(12). However, some jurisdictions are attempting to address these problems in practical ways. Although there are major differences in the political system and culture, the success of Jim Hightower, since his 1983 election as Texas Commissioner of Agriculture, has encouraged sustainable agriculture proponents in Canada. Hightower and his staff have made the previously slow-moving department ". . . a problem-solving partner to assist grassroots economic development" (DeMarco, 1987:66). They have focussed their energies on marketing channels that avoid middlemen, on on-farm diversification, and on value-added possibilities for farmers. They have helped farmer cooperatives get started and have established state certification standards for organic food. Two key elements of their success have been the hiring of committed staff (John Vlcek, Assistant Director of Marketing, pers. comm., July, 1988) and the successful identification of allies and cooperative financial institutions, agribusinesses, and other governmental jurisdictions (DeMarco, 1987). In other words, they have changed their role to become facilitators of the transition and have changed their concept of clients to include a much broader spectrum of the agricultural industry in the state. All of this has been achieved during a period when the agricultural budget has decreased by 14% (Anon., 1987). Hightower has had more latitude to innovate than Canada's executive system would likely allow, but the Texas experience does provide an example of how a department's activities can be turned around rapidly and directed towards new goals with a change in leadership.

5.1.3.2 Designing the food system around the optimal diet(13)

If the central goal of the food and agriculture system is to nourish its population, recognizing the cultural, environmental and economic resources and constraints at hand, then the food production and distribution system must employ strategies to achieve that goal with minimal compromise. Although most of Canada's population does not go hungry, malnourishment is widespread, and is reflected in the high incidence of food related degenerative disease. Ten years ago, the Science Council of Canada (1979) proposed that Canada move towards an optimal diet scenario, but little progress has been made.

Other government jurisdictions have, however, followed this approach. In the 1970s, Norway set out to design its food and agriculture production and distribution system around an optimal diet and adjusted agricultural and regional development policies to meet these dietary targets (Norwegian Ministry of Agriculture, 1975). Goals were established as "end points against which policy must be measured. These goals take primacy over the institutional or functional arrangements of government structures ... " (Winikoff, 1977:552). In other words, the policy was implemented by setting goals and establishing institutional supports, and the result has been changes to the way the food is produced and distributed.

The Norwegian proposal had four main goals: a) to stimulate the consumption of healthy foodstuffs (e.g., increase consumption of grains, potatoes and polyunsaturated fats) and decrease consumption of unhealthy ones (e.g., saturated fats, refined sugars) in order to prevent the incidence of some chronic

diseases; b) to develop guidelines for food production as recommended by the World Food Council; c) to increase domestic food self-reliance from 39% of total calories to 52% by 1990; and d) to achieve regional development in areas lacking an industrial base. A variety of tools have been used to achieve these goals: production and consumer subsidies, marketing promotion based on nutritional quality, consumer education programs, improved labelling systems, and legislation to penalize the production of food and drink detrimental to health (Ringen, 1977)(14). The government recognized that taste cannot be legislated, and that consumer choice and the workings of the marketplace will still play a central role in food purchasing patterns (Winikoff, 1977).

The Norwegian strategy has produced some positive results. Self-sufficiency had reached 50% by 1988 and fat as a percentage of energy in the diet dropped from 40 (1975) to 37 (1987), although undesirable fats have been inadvertently subsidized. Consumption of whole grains, fruit and light milk is up and potato and grain quality have improved. Unfortunately, undesirable declines in consumption of potatoes and fish were experienced and some snack food consumption increased. A decline in cardiovascular deaths has been partly attributed to the Nutrition Policy. Farmers have achieved income parity with industrial workers. Overall, limited changes to organizational structure and a lack of resources have contributed to a lower than anticipated success rate (Milio, 1988).

Similar kinds of initiatives at the municipal level are underway around the world (cf. Haughton, 1987; Toronto Board of Health, 1988), some associated with the World Health Organization's Healthy Cities Project (Hancock, 1989). Ontario has created the Premier's Council on Health Strategy, a multisectoral group with one subcommittee mandated to explore the links between health and food within a healthy public policy context (Thomas, 1988; T. Bisset, Premier's Health Council, pers. comm., Dec., 1988).

Many other dietary considerations to be taken into account when designing a food system around the optimal diet have been identified. Cannon (1988) summarized the findings of reports covering a period from 1965 to 1987, and concluded that most agreed on the need for reducing the intake of salt, confectionery, chocolate, and soft drinks, and increasing whole grains, vegetables, and fresh fruit. Gussow and Clancy (1986) in their review of dietary guidelines for a sustainable agriculture concluded that highly processed food should be avoided and that a much greater diversity of foods (particularly unprocessed ones) than we eat at present should be consumed. A diverse diet has been essential to human nutritional needs since our evolution as a species (Grimme et al., 1986).

A growing body of research on the effects of production systems on food quality suggests that the optimal diet should include foods: a) without pesticide residues (cf. Pim, 1981; Clancy, 1986; National Research Council, 1987; Robbins, 1987), antibiotic residues (cf. Holmberg et al., 1984; Holmberg et al., 1987; Spika et al., 1987) and food additives (cf. Lawrence, 1986; Pim, 1986); b) produced with a complete, balanced fertilization program and not just nitrogen, phosphorus and potassium synthetic fertilizers, which may suppress the uptake of certain other essential elements (cf. Voisin, 1959; Albrecht, 1975; Petterssen, 1978; Knorr and Vogtmann, 1983; Linder, 1985); and c) from animal production systems in which stress is minimized (i.e., minimal confinement, diet for which the animal's gut is well-adapted) (Boehncke, 1983, 1985, 1986, 1988).

5.1.3.2.1 Implications of dietary needs for system design

The main implications for redesigning the Canadian food and agriculture system are profound and include:

1) Major redesign of the farm ecosystem to eliminate most agrochemical from the production process (See Section 2.0).

2) A shift in emphasis toward animal production systems that reduce carcass fat. This usually involves some combination of reducing concentrates in the diet (Norway proposed this), lengthening the growing period and increasing forage intake (cf. National Research Council, 1988; Solomon and Lynch, 1989). Changes of this nature would have substantial farm design and management, and land use implications. Many livestock enterprises in Canada are designed around a high concentrate diet and rapid fattening, especially in beef, swine and chicken production. Many farms rely on purchased feed and have insufficient land to grow their own grains and forages. Manure disposal is an associated problem(15).

The specific policy response to support a reintegration of farm operations is unclear in light of an extended history of promoting specialization. Many of the initiatives outlined under efficiency and substitution will create an environment conducive to diversification and this will produce some integration of operations. Pricing policies that encourage the production of undesirable products will need to be removed to eliminate inconsistencies (Kramer, 1988). Some jurisdictions have come at the problem from a different angle by legislating the kinds of animal production systems that will be permitted. Some OECD countries have limited the number of pigs, layers and broilers that can be kept on a single enterprise (OECD, 1988). Sweden has banned certain kinds of intensive livestock systems, and has provided guidelines for acceptable ones (Animal Protection Act, passed May 27, 1987). Switzerland will soon complete a 10-year phasing out of battery cages. Most farms in that country have switched to aviaries as a result (Webster, 1989). Such actions have less direct impact on land use but do create an environment that encourages changes.

A USDA Assistant Secretary of Agriculture proposed to the Senate Subcommittee on Conservation that support be provided for the creation of "nutrient" cooperatives of livestock producers and cash crop operations (Anon., 1989c). Feed would be supplied from one and manure returned to the other. To facilitate the development of such cooperatives in Canada, technical assistance would be required and some marketing board rules would need modification. Proper composting of manure before transport would reduce costs and raise the value of this soil amendment.

Many provinces presently monitor the sale of agricultural land, and in some cases approval must be granted for the sale to go through. A different type of cross-compliance could be employed whereby a buyer would have to demonstrate that land consolidation would increase farm diversification and improve soil quality. If this could not be satisfactorily demonstrated, the buyer would not be eligible for technical and financial assistance. (See below for further discussion of strategies for changing land use patterns.)

Two further benefits of reducing concentrates and increasing forage in the animal diet are better energy conversion, and reduced competition between humans and animals for human food sources in a world experiencing starvation (cf. Lappé, 1971; Engelhardt et al., 1985).

3) Focus on production for the fresh market and minimal processing. Canadians have been consuming more fresh food for some time (Kramer, 1989), and this trend would continue, at least during the growing season, under an optimal diet scenario (cf. Grimme et al., 1986). To meet this requirement, and the other goals of a sustainable food system, more regionally designed distribution systems are necessary. There are also significant implications for the food import and export economy, which are discussed below.

The processing industry would become more seasonal. Demand for many products would slump dramatically during the Canadian growing season, but rise substantially during the off-season if fresh imports were restricted to meet other sustainability goals. This is also desirable from an optimal diet perspective, as it appears that properly frozen or canned local produce is nutritionally as good or even superior to "fresh" produce shipped over long distances (Kramer, 1989). Herrin and Gussow (1989), in a preliminary analysis of a sustainable diet scenario for Montana, suggested that much greater reliance on local produce year round would not create nutritional problems. The difficulties for the processing industry, however, would have to be addressed.

Certain forms of processing would be discouraged, such as removal of fibre from grains; bleaching; addition of salt, refined sugar, food additives; and boiling in fat, oil or water (Hall, 1974, Silverstein, 1984; Grimme et al., 1986).

4) A more diverse diet means more diversified production. To meet other sustainable agriculture goals, this diversification should be achieved within farm units rather than by creating specialized production systems to produce new crops. Limited diversification has been occurring on farms producing animal feed and industrial crops (cf. Campbell, 1987; Joliffe and Snapp, 1988; Joliffe, 1989), but opportunities for diversification through imported human food substition have not been well explored. Some work has been done by the Simcoe Research Station, as part of Ontario's adjustment program for tobacco growers (cf. Press and Elliot, 1988). Herrin and Gussow (1989) concluded that Montana could meet all its winter vitamin C requirements with local production of potatoes, cabbage and sprouted seeds. No imported citrus or out-of-season fruits and vegetables would be required.

5.1.3.2.2 Addressing consumer choice

Consumer choice is a major concern. In Norway, food production and nutrition information was provided to motivate better dietary habits and to develop skills for making more informed food choices. The government recognized that . . . "present marketing practices are in relatively large disaccord with the nutritional objectives . . . The factors which today regulate sales are only to a small degree dictated by nutritional considerations." (Norwegian Department of Agriculture, 1975:72). These words also describe Canada's situation. A number of strategies for addressing this marketing problem have been discussed in previous sections. Ultimately the marketing and advertising of food must have as the central principle that consumers be provided an opportunity for "fully informed" choice. This requires that policy makers believe that people are capable of making informed decisions if they are provided with full, comprehensible information, and that marketers and advertisers be committed, or forced, to provide more substantial information on their products.

Consequently, changes would be required for grading, labelling and advertising. Grading systems presently reflect largely cosmetic, rather than nutritional considerations (Pimentel et al., 1977; McKinney and Gold, 1987; Feenstra, 1988; Rosenfeld, 1990). Instead, grades should reflect the products compliance with optimal diet criteria. An example is provided in Table 52. Current labelling regulations are based on a very narrow conception of nutrition. Little information on the food production process is provided, and often incomplete information is included concerning ingredients, nutritional value and possible contaminants. A recent survey by the Grocery Products Manufacturers of Canada concluded that 80% of consumers read ingredient labels on packaged foods, up from an estimated 2% in 1983 (Bertin, 1989c). Unfortunately only about 20% of packaged foods in Canada carry nutrition labels (Grier, 1990). A comprehensive index system could be included on labels to indicate compliance with optimal diet and

other sustainability criteria. An example of such a label is provided in Figure 10. Creating such an index is a difficult task, but the federal government's "Environmentally Friendly Products" program provides a base of experience, in terms of both data and process. As well, a number of non-profit organizations, promoting ethical investment and purchasing, have developed systems for rating products (cf. Elkington and Hailes, 1988; Will et al., 1988; Pollution Probe, 1989).

In 1986 Canadian grocery retailers spent $2.5 billion in advertising (Matas, 1987). Although advertising can contribute to market efficiency by providing consumers with information, it can also be part of a process of misinforming or partially informing the public (Singer, 1986). The costs of misinformation are borne by consumers, directly in product prices, or indirectly in lost tax revenues(16). There are also serious questions about the economic value of advertising. Some studies suggest that it often is not cost effective, and that it contributes to waste, market power and higher prices (Singer, 1986). Although extensive regulations exist to control how products are advertised (Consumer and Corporate Affairs, 1988), their focus is on preventing obvious fraud as opposed to creating a framework for providing full product information.

The Science Council of Canada (1979) proposed that advertising of nutritionally-questionable products be curtailed by government intervention. This could be one component of an integrated strategy to promote the optimal diet and eliminate or restrict advertising that constitutes a barrier to achieving this goal. One possible requirement is that food products that are undesirable or peripheral to the optimal diet be labelled as such.

5.1.3.3 Weaning Canada from the import-export agricultural economy

Canada enjoyed a balance of agricultural trade surplus of $1.76 billion in 1989 (Agriculture Canada, 1989c). Grain and oilseed exports have been the major contributor to this positive trade balance, with $5.2 billion in export sales (1989/90) (Agriculture Canada, 1989c), largely from Prairie production. The other regions of Canada, however, are net importers of agricultural products. Our reliance on the Praire grain economy for a favourable agricultural trade balance has placed undue economic and environmental pressure on a narrow range of production sectors and practices. Dependence on imported food, on the other hand, has resulted in resource inefficiencies (those that are largely considered externalities because they are not measured in the market place), and a less nutritious food supply. This section explores the proposition that designing a truly sustainable food system requires that Canada be much less dependent on the import-export economy.

5.1.3.3.1 Self-reliance

Policies of self-reliance are controversial, especially in our present free trade environment. In the 1989 Throne Speech, the federal government expressed its desire to facilitate the development of a more self-reliant agricultural sector, but its interpretation involves a very shallow "commodity", and market oriented understanding of the concept without acknowledgement of the broader ecological viewpoint. The rationale for self-reliance has been provided elsewhere (e.g., Science Council of Canada, 1979; Warnock, 1982; Morris, 1982; Ekins, 1986a; Meeker-Lowry, 1988; Kneen, 1989a), and has been summarized by Meeker-Lowry (1988:167): "Self-reliance in socioeconomic systems has its analogue in natural systems. As a general rule of natural process, energy (and subsequent action) are captured or expended as close to the point of origin as possible".

In this context, Harnapp (1988) has listed four problems of import reliance: a) increased vulnerability to disruption of the food supply (e.g., Chilean grape incident of 1989, 1981 California Medfly scare); b) energy inefficiency and costliness (i.e., the average food molecule in the USA travels 1300 miles [Cornucopia Project, 1981], transportation costs amount to 8% of consumer supermarket expenditures); c) less nutritious food (e.g., vine-ripened tomatoes can have 25-30% more vitamin C compared to those ripened with ethylene gas); and d) a local economy potentially weakened by monetary leakages ($4 billion left Ontario in food import expenses in 1985, 80% of the amount spent, i.e., only 20% of consumer expenditures on imports remain in the province).

Generally, strategies for building self-reliance have three elements: a) plugging resource and monetary leaks; b) encouraging new enterprises to build on local strengths; c) recruiting only those businesses that can develop using underutilized resources (Rocky Mountain Institute, 1986a).

Canada could plug a number of leaks in its food economy. For example, just after World War II Canada was self-sufficient in basic fruits (plums, peaches, apricots, strawberries, pears), but by 1980, 28-57% of these five fruits were imported (Warnock, 1984). In 1987, Canada was only 71% self-sufficient[(17)] in fresh vegetables, 90% in canned vegetables, almost 100% in frozen vegetables, and 45% in fruits and berries (Statistics Canada, 1988). However, such national figures hide regional differences. For example, Saskatchewan has been estimated to be only 10% self-sufficient in vegetables (Canadian Organic Producers' Marketing Cooperative, 1984). Some of this is explained by the seasonality of Canadian production and storage, but many products, such as cabbage, onions and carrots, are still imported during both ideal production or storage periods (Warnock, 1984). Over the years we have lost much of our processing capacity in certain sectors, such as tomatoes (OPIRG, 1979). We are net importers of apple juice concentrate (Aubé, 1988), even though we produce large quantities of apples.

More complete assessments of the flow of goods on a regional basis are required in order to obtain a more accurate picture or our reliance on imports, and the degree to which this can be reduced as part of our efforts to achieve sustainability. The Cornucopia Project has produced a manual for state self-reliance analysis (Cornucopia Project, 1982) that has been used to develop a number of US state reports. This kind of information would help identify priority action areas. Undoubtedly, the data would reveal strategic requirements in production, processing, manufacturing and distribution. Many of the strategies that have been discussed here, and others that government has traditionally relied upon, could be employed to promote self-reliance. Nor do we need to feel alone in this effort. A number of US states have specific programs promoting self-reliance and state value-added food projects (Greene, 1988; DeMarco, 1989). In the short-term, the strategies would have to reflect the outcome of the current Uruguay round of GATT negotiations.

5.1.3.3.2 Changes to land use patterns

Loss of prime agricultural land is one of the greatest threats to self-reliance. The latest Statistics Canada figures show that 6.5 million acres of agriculture land were lost to other uses between 1951 and 1986 (Burke, 1988). Projections are that this trend will continue, at least through 2001 (Yeates, 1985). Between 1966 and 1981, 57% of all rural land converted to urban uses was prime farm land (Class I-III) (Yeates, 1985).

Warnock (1982), in his study of self-reliance in British Columbia, concluded that maintaining the level of self-sufficiency at 47% would require a 40-60% increase in production to the year 2000. This would

still leave the province far short of its desired ultimate objective of 65% self-sufficiency. Fruit and vegetable production per capita (two production sectors for which the target is achievable) had been in decline for many years. Warnock concluded that the land base for achieving self-reliance in fruits and vegetables was not being maintained. Harnapp (1988) concluded that Ontario would need over 9 million acres of land in food (as opposed to non-food) crop production to be self-sufficient at present consumption patterns (presently under 9 million acres is in crop land, and some of that is in non-food crops). A major decline in red meat consumption would, however, dramatically decrease land needs. Similarly, Eastern Canada (Ontario east) would likely need to reduce levels of dairying if it wished to reallocate land use to achieve greater self-reliance (Warkentin and Gertler, 1977).

Maintaining a high quality land base is essential, then, for achieving sustainable agriculture. A variety of strategies have been used in Canada (cf. Science Council of Canada, 1979; Furuseth and Pierce, 1982) with varying degrees of success. Ontario and British Columbia, where urban pressures are the most intense, have not succeeded in substantially reducing the rate of loss (Warren et al., 1989). There are many potential legislative strategies that can be used and that have been tested in other jurisdictions (cf. Steiner and Theilacker, 1984).

Some non-governmental initiatives should also be supported. For example, community land trusts (CLT) are growing in popularity in the USA, and more slowly in Canada. "A community land trust is an organization created to hold land for the benefit of a community and of individuals within the community. It is a democratically structured nonprofit corporation, with an open membership and a board of trustees elected by the membership. The board typically includes residents of trust-owned lands, other community residents, and public-interest representatives. Board members are elected for limited terms, so that the community retains ultimate control of the organization and the land it owns." (Institute for Community Economics, 1982).

Land for trusts is donated or purchased, with the idea that the trust will control it in perpetuity. The land is then leased for long time periods for purposes determined by the trust, at costs generally much lower than the market value (Berger, 1983). The key concept is to separate the use value of the land from its speculative value. Leasees can own buildings and land improvements (Institute for Community Economics, 1982; Turnbull, 1986), which in agriculture would include soil improvement measures such as green manuring and compost additions. The value of such improvements is negotiated with the land trust corporation, although for many improvements existing trusts have developed value guides (Robert Swann, Southern Berkshires Community Land Trust, pers. comm., July, 1989).

Investors can contribute directly to the purchase of land for a particular CLT or can contribute to a community development loan fund (CDLF), such as the Revolving Loan Fund (RLF) of the Institute for Community Economics. This particular loan fund has raised approximately $5 million U.S. from over 200 investors (80% of them individuals), and has placed about 130 loans (60% to CLTs, mostly for urban housing). The financial performance of the RLF has been very good, with a loan loss rate of only 0.05% (Matthei, 1987), below the industry average.

Sustainable farming practices are well-suited to the CLT framework because most rural CLT's specify that the land must be used in ecologically and socially benign ways (Institute for Community Economics, 1982). The flexibility of the CDLF in terms of typical rates of return, size of loans, eligibility criteria, and repayment schedule, is an important component of the fund's ability to assist the community and find suitable investors (Keith and Matthei, 1983). This also makes this concept an attractive one for

sustainable agriculture.

The CLT approach should also be of interest to more traditional lenders, and to borrowers who are seriously in arrears on payments. Recently, as land values have dropped, many lenders have been unable to recover their principal by selling the assets of a delinquent client, so they have been examining other ways to keep their clients viable. The Farm Credit Corporation (FCC) and private investors have been involved in leasebacks, but many farmers are opposed to them for fear that they encourage sharecropping, and could have negative impacts on the rural community (Senate of Canada, 1988; Bertin, 1989b). Others are concerned that tenant farmers are less likely to adopt environmentally sound farming practices, especially over the long term (Batie, 1986; Van Vuuren and Ysselstein, 1986). To address these concerns, title to land could pass to a land trust, and the client would then pay rent, which would be passed on to the lender. The FCC and provincial agencies could encourage the formation of land trusts or non-equity cooperatives (Kneen and Kneen, 1987). These instruments would be distinctly different from the equity trusts that have been proposed by the FCC (Senate of Canada, 1988). Two provinces in Canada (Manitoba and PEI) have programs to support the formation of cooperatives and provincially-administered land banks that might be vehicles for this approach.

One further variation on this theme is the transfer (sale) of land to a land holding corporation that leases the land on a 25-45 year lease basis to farmers. This could involve a variable lease rate reflecting the difficulties of beginning farmers. The economics of such arrangements have been explored by Baker and Thomassin (1988).

The federal government should also investigate how conservation easements could be used to protect agricultural land. A great deal of activity is underway in the USA using easements in this way (cf. Sand, 1985; Ward et al., 1989). Although easement provisions are not specifically designed for land preservation, they are being used to protect areas from development. A small amount of related work has been done in Canada (cf. the work of the Ruiter Valley Land Trust, Mansonville, QC). The taxation environment, however, appears not to be as favourable for conservation easements in Canada as it is in the USA.

5.1.3.4 Ideas on financing transition programs

A thorough investigation of how to finance the transition is required, but some initial thoughts on where investigators could look is presented here. It is assumed that, in global budgetary terms, no influx of new money for sustainable agriculture can be expected, and that, for the most part, money will have to be reallocated from other budget categories.

5.1.3.4.1 Efficiency

Efficiency strategies involve small costs and may involve some savings. For example, the Canadian-Saskatchewan Crop Insurance Program offering higher payouts to organic farmers could actually result in reduced per farm payments vis-a-vis conventional growers. Organic producers often are not so affected by climatic and market variability (Culik et al., 1983; Gliessman, 1985; Helmers et al., 1986; Hanson et al., 1990). In effect, sustainable production practices help to smooth out the boom and bust cycles so common to agriculture because yields do not fluctuate to the same degree as in conventional production. Stabilization programs could be affected in a similar way.

5.1.3.4.2 Substitution

Substitution strategies are most effectively funded by the reduction or elimination of other programs. For example, the Agriculture Canada's Research Branch has been reviewing its research priorities and is likely to reduce emphasis on some research in favour of financing sustainable agriculture research initiatives. Additionally, many substitution strategies are potentially less expensive. For example, on-farm research programs carried out in Nebraska with the cooperation of the University of Nebraska agronomists and the Practical Farmers of Iowa, were estimated to cost less than ten percent of similar projects carried out on research station plots (Richard Thompson, Practical Farmers of Iowa, pers. comm., November, 1988).

Many other substitution strategies can be funded from within existing programs. There will be an opportunity cost for other areas of agriculture, but this is unavoidable if the government is to truly commit itself to sustainability. Some strategies, such as modified taxation provisions, are potential revenue raisers. The overall economic spin-offs from sustainable agriculture have yet to be fully explored, however, the Advisory Panel on Food Security, Agriculture, Forestry and the Environment (1987) calculated that the costs of subsidies could be recovered by government from the taxes paid by both expanding and new sustainable agriculture enterprises (farms, retail and wholesale outlets, processors).

5.1.3.4.3 Redesign

At least four promising areas are apparent from which revenue could be generated to fund the redesign of the food system: subsidy modifications; changing the process of registration, testing and monitoring of agricultural materials; reduction of health care costs; and tax provisions.

The Environmental Council of Alberta (1988) estimated total provincial / federal subsidies to agriculture at $7.3 billion. With priorities shifting to sustainable practices, subsidies to practices that restrain or prevent the development of sustainable systems need to be phased out in favour of supports for the kind of initiatives described here. Detailed analyses are required of which subsidies to remove, in which sequence, and over which time period. Such analyses could build on previous work (cf. Goodloe, 1988; Bollman, 1989), but would require greater emphasis on sustainability issues.

Substantial monies are spent on pesticide and food additive registration, review, testing, and monitoring. The Auditor General (1988) has estimated that it will take 33-55 years to reevaluate old pesticides in light of current information and concern, a tremendous commitment of resources. But if a shift to preventative pest control strategies and an optimal diet scenario takes place, the need of and use for such products would decrease. Monies budgeted for pesticide evaluation would thus be available for other activities. With the emphasis on preventative strategies, the government is not required to assist companies developing these products. In this context, it is consistent for companies wishing to register curative products to pay all costs associated with the process. Budget savings would be experienced in the Departments of Agriculture, Health and Welfare, and Environment.

Increasingly, health care and nutrition researchers are finding more direct connections between food production, processing practices and health problems. Salmonella food poisoning is one of the more obvious ones. Yearly costs to the health care system associated with this are estimated at $477 million at a minimum (Auditor General, 1988). Some percentage of these poisonings are related to the development of resistance in salmonella due to sub-therapeutic applications of antibiotics, or from stress-related conditions in animals which create an environment in which diseases can develop. If sub-therapeutic

doses of antibiotics were not used in the production system, the incidence of salmonella poisonings, and the associated costs for health care, would be reduced. Other areas for which we have little data include the costs to the health care system of acute and chronic exposure to pesticides and food additives, and the implications of an optimal diet scenario for health and health care costs. We know enough at this point, however, to say that sizable savings are possible (cf. Todd, 1989).

For several decades in Canada, debates have raged about the tax regime, the debate touching on a range of topics with much broader implications than just agricultural production and distribution (cf. McQuaig, 1987). Conscious and unconscious decisions are being, and have been, taken to discourage sustainable development in general and sustainable agriculture in particular. Research on the USA tax code gives us some indication of how to generate revenues to support more sustainable practices (cf. Ward et al., 1989).

5.1.3.5 Redesigning the management of the organization

Organizations have their own ecology (Plumptre, 1988; Morley and Wright, 1989), an ecology that can potentially mimic that of the systems with which they are concerned (Walters and Holling, 1984; Solway, 1988; Morgan, 1989a). This has largely not been the case, unfortunately, for institutions dealing with essential ecological functions, although management theory has been moving in this direction for some time, and has been applied to the management of some businesses and organizations (cf. Peters and Waterman, 1982; Wright and Morley, 1989).

Current government management systems have been characterized by: a lack of long-term direction; weak control by individual units over their resources; too many relationships to maintain; a lack of clear indicators of success and failure; weak feedback; a lack of flexibility for reward systems; stifled creativity, which diminishes the contribution of the individual in favour of the institutional culture; and paralysis associated with "infoglut" (Plumptre, 1988). Such an organizational environment is unlikely to support the redesign of the food and agriculture system. The challenge is to consciously redesign the organization and management of government departments in order that they facilitate the emergence of a redesigned food and agriculture system. "Design has to do with putting things together, finding connections to build upon, and focusing on the spaces between to produce an innovative arrangement." (Wright, 1989:217). What follows are patterns for the designing of institutions responsive to ecological realities, in this case, sustainable agriculture.

A key concept is that of "fit", that the organization must fit into the environment with which it works (Plumptre, 1988; Kolodny, 1989). States Morgan (1989a:55-56), ". . . the internal diversity of any self-regulating system must match the complexity of its environment if it is to deal with the challenges posed by that environment". With the fit concept, the organization is seen as an entity with interdependent parts and interdependence with its environment. The language of "fit" is ecological. People speak of the organization as a miniature ecosystem, of its uniqueness, of symbiotic relationships, internal consistency and integrity, and of complex webs of relationships, processes systems and structures.

Some of the organizational implications of current management practices for agricultural organizations are listed in Table 53 and are related to the ecological laws discussed earlier in Table 4. These ideas are particularly important for government units, such as departments of agriculture, dealing with intangible outcomes that can not be controlled or predicted, in contrast to units whose work is routine and often

involves physical goods (Plumptre, 1988). The most critical ecological realities for organizational design relate to law #5 (Table 4), the tendency for ecosystems to transform in radical, unpredictable ways once a threshold has been crossed (Solway, 1988). Such transformations are often both large and irreversible (Walters and Holling, 1984). In agriculture, examples of these transformations include the fairly rapid development of a farm financial crisis in the early eighties and the appearance of agricultural pollutants in high concentrations in a variety of water supplies. The organic food industry appears to be experiencing a threshold phenomenon at present. After years of being perceived as a marginal agricultural activity, organic food supply is suddenly unable to meet demand. Agricultural professionals are studying organic farming systems at unprecedented levels, and government departments are scrambling to develop policy initiatives to support this system of farming. In most cases, governments have been slow to recognize the nature of the threshold phenomenon and have failed to take appropriate action, primarily because the organizational design has not "fit" or corresponded to the realities of the organic "environment".

How should an organization be designed to be able to respond quickly and effectively to such thresholds? First, it must be able to recognize the approach of a threshold by monitoring early indicators. This requires that the organization be close to its "clients" and their environment. It must have well-established intelligence networks that do not collect all the information available, but instead focus on the key indicators that herald changes. Institutional response is triggered not by exhaustive technical analysis, but rather by the presence of key indicators of potential changes (see Table 54 for agricultural examples). A frequent limiting factor is the lack of professional agroecological training and the dominance of positivist, reductionist paradigms in most scientific and economic disciplines (see Section 5.2.2). A continuous feedback process is also required to monitor the outcomes of actions taken and suggest modifications to future actions (Morgan, 1989a). The search for solutions also follows a different process. Hill (1986b) has outlined the characteristics of an alternative problem-solving model and contrasted it with the predominant approach (Table 55).

Problem-solving teams are formed, and staffed with generalists having somewhat vague job descriptions, to respond to an emergent problem. The broad training of the staff allows for reorganization of units for each new task (Morgan, 1989a). Teams are often "competing" to develop the appropriate solutions, each approaching the problem from a different angle. This approach, known as "redundancy of function", spreads risk and produces greater diversity of thought and action (Morgan, 1989a; Morley, 1989).

Such changes need not be perceived as radical departures from existing practice. The Auditor General (1988) identified a number of governmental units operating in accordance with some of these principles. These units emphasized people, participative leadership, innovative work styles, strong client orientations (ear to the ground), and optimum performance. The task is to build on such positive models.

Notes

1. Note that the agroecological concept of diversification is considerably more sophisticated than the limited economic one that is currently espoused by governments and large agribusiness firms (see Kneen, 1990 for a discussion of the limitations of the latter).

2. Other problems with crop insurance, not related specifically to issues of sustainability, have been identified and need resolution. For example, fixing the price of the insured yield early in the season means that subsequent crop price changes are not reflected in the insurance (Economic Council of Canada, 1988). A further problem is the absence of equivalent programs for forage, pasture and

livestock, and this may be discouraging the reintegration of livestock and cropping systems. The recently announced red meat stabilization program (Bertin, 1989a) could help to alleviate this imbalance.

3. Although no comprehensive Canadian study of the supply needed to furnish an organic dairy has been performed, a British company has established a pilot program to process 1000 l of organic milk/day (Anon., 1989b) and one West German estimate is that 3000 l/day are required for that country (Grosch, 1985).

4. Most of the substitution strategies are school-of-thought neutral except where indicated, i.e., the needs of different sustainable agriculture schools of thought can be addressed by the same kind of strategy.

5. Not only does the market for transitional products need exploring, but also some concerted work needs to be done on definitions and standards. Some Canadian certification agencies have done preliminary work on developing transitional standards and the state of Texas has a transition label. Note that developing hay markets is not seen as viable within a sustainability context except in the situation where field crop producers join with animal producers to exchange feed for manure (Anon., 1989c). This is because hay exports can result in a serious decline in soil K and this can usually only be made up by importing K fertilizer onto the farm (Vogtmann et al., 1986). An even more serious deficit can be experienced by grain producers, especially those exporting more than 25% of their production (Zettel, 1988).

6. The recent FCC restructuring suggests that they are now less interested in being an instrument of government policy (Bertin, 1989b).

7. Note that a number of jurisdictions in Europe and North America have had these kinds of programs for some time, but their emphasis is usually more on waste management than creation of sustainable agriculture systems. As a result, the programs may actually be creating problems for some farmers who have participated and are now interested in undertaking a transition. Experience with Québec dairy farmers involved in a transition program funded by Entente Canada-Québec shows that the liquid manure handling systems promoted with subsidies by the province may be limiting fertilization and crop rotation options.

8. It is not clear to what level production would have to rise for premium price levels to fall (see discussion above in Section 2.6).

9. Unfortunately, some of these changes are now being questioned in Congress.

10. Oates (1988), on the other hand, opposes the use of tax revenues for environmental activities and as a means of quelling industry objections. He feels that tax revenues should become part of general revenues in order to counter the effects of the many welfare-distorting taxes that governments have imposed.

11. Note that many pesticides may soon disappear from the market place. The USA Environmental Protection Agency (EPA) had cancelled 20,000 pesticide registrations by mid-1989 (DeVault, 1989).

12. See Benello and Roussopoulos, 1971; Satin, 1978; Friedmann, 1981; Barber, 1984; Dryzek, 1987 for some discussions of this topic.

13. Optimal diet does not mean population average. Each individual has unique dietary requirements (cf. Williams, 1974). We are also dealing not only with what people consume but also its quality. The traditional view of appropriate diet has not fully considered the implications of poor quality food on

health (Grimme et al., 1986).

14. Many may feel that such strategies are utopic in our present Free Trade Agreement environment, and because of the on-going controversy surrounding GATT agricultural negotiations. But this environment did not develop out of nowhere. It is the product of concerted efforts to achieve it. In the long-term context of redesign, work can be done to create an environment conducive to designing around the optimal diet. Even within the current GATT discussions, there appears to be room for transition payments to farmers in LISA-type programs (American Soybean Association, 1989). As well, little attention has yet to be given to the impacts of GATT on environmental and agricultural sustainability.

15. There is considerable debate regarding the land base required to maintain acceptable production levels for domestic use and export if there is widespread adoption of integrated sustainable systems. See Section 2.6 for a partial discussion.

16. The full costs of advertising are not paid by the firms who purchase advertising services due to favourable provisions in the tax code (McQuaig, 1987).

17. Canada's production as a percentage of disposition (manufacturing and food use).

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Strategies to overcome institutional barriers to the transition from conventional to sustainable agriculture in Canada: the role of government, research institutions and agribusiness

by Roderick John MacRae, PhD

6.0 Conclusions, self appraisal, further research and summary

Using qualitative research methods, a comprehensive agenda for changing the work of agricultural institutions has been presented in this study (see summary below). This agenda includes both changes to the way institutions are organized, and also changes to the content of their decisions. All this information has been categorized according to an efficiency / substitution / redesign framework.

The validity of qualitative research is always a critical question. This study suffered somewhat from my lack of experience with qualitative investigations. When I started this study I was not even sure that I was undertaking a qualitative study. The study's design emerged very gradually as I slowly clarified my thinking on what I was trying to achieve. As a result, some of my early work on research institutions suffers from a lack of clarity regarding my objectives, and the framework that would best allow me to understand the vast volume of information available. My record keeping could also have been more exact. I did not keep a detailed diary, with all my notes clearly assembled. If I had done so, a design would have likely emerged earlier, and I would not have lost as much time as I did trying to reconstruct certain lines of thinking.

This work is original in three main ways. First, the use of these qualitative methods for evaluating sustainable agriculture institutional policy and action has never, to my knowledge, been attempted in Canada. Second, no one has successfully synthesized the volume of information dealth with in this project. Third, the efficiency / substitution / redesign framework has never been used before in this manner.

Evaluating this study against the requirements for validity outlined by Reason and Rowan (1981b) (Section 3.4, Tables 17 and 18) gives me confidence in the work performed. I have not used the two most common forms of validity found in positivist paradigm research (measurement and experimentation), but instead have concentrated on those aspects of validity that are less commonly used in positivist analyses, and those that are associated with new paradigm investigations. I have relied enormously on the ideas of others active in the food system to test my thinking. I have incorporated almost every data point into some part of the thesis, on the assumption that everything told to me has a significance that I must

discover. I have constantly attempted to clarify my assumptions in order to ensure that my personal distresses have not limited my ability to understand the information before me. I have learned a tremendous amount about myself in the process. I have attempted to use many forms of knowing to confirm or disconfirm my ideas. I would, if I could start over, organize the thesis in a different manner. A diary-style presentation would probably have been more useful. I have found it quite difficult, using the traditional scientific thesis form, to clearly convey to the reader how my thinking has evolved in this study. In case this evolution is not clear, let me reiterate that preparing this thesis has been the most tremendous learning experience of my life.

An enormous on-going reesarch and action agenda flows from this work. A detailed vision of a sustainable food system in Canada has yet to be thoroughly spelled out (although several initiatives are underway), and the most efficient steps to attain it have yet to be clearly identified. In particularly, almost all aspects of redesign are poorly understood. Much conceptual thinking needs be done in such areas as: the regional land use implications of sustainability, how the optimal diet scenario will affect food production patterns, how to gradually ease Canada away from its dependence on the export grain economy without completely obliterating the rural character of Western Canada, and the implications of widespread transition for the food processing sector. But concepts will not be enough. These areas will have to be investigated in the context of an achievable action agenda, one that can be taken up by many sectors, institutions and citizen groups. Their successes and failures will be the ultimate arbiters of the validity of this particular work.

Summary of strategies proposed

Governmental and para-governmental institutions

Efficiency strategies

1 Modify programs that limit agricultural diversification

2 Modify programs that specifically restrain sustainable agriculture

Substition strategies

1 Develop agroecology training for scientists, farmers and extension agents

2 Perform research and provide technical supports for marketing and quality control

* Regulatory and financial support for certification

* Support for direct and local marketing

* Institutional purchase of organic foods

* Market research on products of sustainable practices

* Provision of comprehensive consumer information

3 Develop safety net and production incentive programs for sustainable agriculture

* Crop insurance

* Credit assistance

* Production subsidies

* Tax provisions

* Land use regulations

Redesign strategies

1 Change the role of the state in agricultural development

2 Redesign the food system around the optimal diet

3 Wean Canada from the import-export agricultural economy

4 Redesign the management of government departments and para-governmental agencies

Research institutions

Efficiency strategies

1 Scientist retraining

2 Perform research impact assessments on projects in development

3 Reward scientists for all their activities

4 Limit government financing of projects designed to develop products that will be marketable by agribusiness firms

5 Allow funding program staff a small discretionary budget for risky projects

Substitution strategies

1 Offer sustainable agriculture teaching programs

2 Establish sustainable agriculture research facilities

3 Develop on-farm research networks

4 Develop rewards for sustainable agriculture research projects

5 Assemble multidisciplinary research teams with facilitators

6 Create a funding program specific for sustainable agriculture projects

Redesign strategies

1 Redesign the pedagogy of the agricultural curriculum

2 Redesign the reward criteria and the evaluation process

3 Perform new paradigm research

4 Redesign the structure of the research institution by creating flexible interdisciplinary teams of scientists that are created and disassembled with each task

5 Redesign funding agency function

6 Perform research on a new agroecological research agenda

Agribusiness

Efficiency strategy

1 Corporate greening

Substitution strategies

1 Develop new or modify existing structures to confront corporate power

* Marketing boards and coops

* Citizen information networks

2 Organize consumer action

* Selective purchasing

* Ethical investment

3 Change the characteristics of and regulations governing the corporation

* Return the legal status of the corporation to its original form

* Increase shareholder control

* Restrict mergers and acquisitions

* Revise the tax code

* Increase shareholder, director and management liability

* Broaden the ownership base

Redesign strategies

1 Support the development of alternative enterprise forms

2 Develop an ecological economics

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