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

by

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Abstract

Ph.D. Roderick John MacRae Renewable Resources

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

Literature on sustainable agriculture was examined using qualitative research methods to identify institutional barriers to the transition to sustainable agriculture, and solutions to overcome them. Information was also collected from different participants in the food and agriculture system by conducting interviews and workshops, and by soliciting comments on discussion papers of preliminary findings.

An explanatory scheme (or general theory) was developed to organize strategies for overcoming institutional barriers using an efficiency - substitution - redesign framework. Efficiency strategies involve minor changes to existing activities, resulting in more efficient resource use. Substitution strategies involve replacing one product, technique or activity with another. Redesign strategies require solutions and institutional activities that mimic ecological processes. Solutions consistent with each category are analyzed and discussed in the areas of research, education, technology transfer, government programs and regulations, taxation, safety nets, consumer activism, marketing and advertising, corporate legal status, and organizational design and management.

Résumé

Ph.D. Roderick John MacRae Ressources renouvelables

Des stratégies pour surmonter les obstacles institutionels à la transition de l'agriculture conventionelle à l'agriculture intégrée au Canada: le rôle des gouvernements, des institutions de recherche, et de l'entreprise privée

La littérature traitant de l'agriculture intégrée fut evaluée avec des méthodologies qualitatives de recherche afin d'identifier les obstacles institutionels à la transition à l'agriculture intégrée et les solutions pour les surmonter. De l'information fut aussi obtenue par des entrevues et des ateliers réunissant une gamme d'intervenants du système agro-alimentaire, et par la solicitation de leurs commentaires sur des documents de travail traitant des résultats préliminaires.

Afin d'organiser les stratégies pour surmonter les obstacles institutionels, un schéma explicatif (ou théorie générale) fut développé autour d'un cadre "efficacité - substitution - conceptualisation". Les stratégies d'efficacité impliquent des changements minimes aux activités actuelles et produisent une utilisation plus efficace des ressources. Les stratégies de substitution comportent le remplacement d'un produit, d'une technique ou d'une activité par d'autres. Les stratégies de conceptualisation exigent des solutions et des activités institutionelles qui imitent les processus écologiques. Des solutions propices à chaque catégorie sont analysées et discutées dans les domaines suivants: recherche, éducation, transfert technologique, programmes et réglementation gouvernementaux, taxation, filets de protection financière, activisme des consommateurs, mise en marché et publicité, statut légal des corporations, et gestion.

Suggested short title

Overcoming barriers to the transition to sustainable agriculture

MacRae

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A final special word of thanks to great friend, colleague and mentor, Stuart Hill, for sharing with me his unique way of seeing the world, and to Herb and Mary for always supporting and loving me as I follow the twisting path.

Preface

I wrote the first outline for this thesis project in 1983 while working in Toronto for the Ontario Public Interest Research Group (OPIRG). My hope was that OPIRG would take it on as one of its principal public research and education projects. This did not come to pass. My experience with OPIRG was very formative, however. I learned a great deal about power in society and how social change comes about. It solidified my commitment to always being involved in promoting social change, and maintained my desire to carry out this research project.

When Stuart Hill asked me to come work for him at Ecological Agriculture Projects, I realized that it created the perfect opportunity to undertake the project. I would have access to all the necessary resources, and to Stuart's vision, experience, analysis and companionship. Although Macdonald College did not have a tradition of supporting "action-research", multidisciplinary theses, I felt my familiarity with the school would compensate for a lack of academic structure to support me.

I have been around the College most of my life. My father was doing graduate work in Agricultural Chemistry when I was born. My mother is a graduate of the School of Dietetics. After a brief sojourn in Ottawa, my father joined the Department of Animal Science and we lived around the College until we moved to Nova Scotia when I was fifteen. My father had taken a position as Principal of the Nova Scotia Agricultural College. After high school, I went to Acadia University and, after a rather circuitous journey, ended up with a B.A. in history. After my second year, I spent a summer working in Ghana as part of Canadian Crossroads International's development education program. I was profoundly affected by that experience and it ultimately convinced me that I should be involved in agricultural development. I decided that I would return to Macdonald College to do a Master's degree in Soil Science. My thinking at that point was that solutions to hunger in the world were directly connected to food production techniques. It is somewhat ironic that I had to go to West Africa to become interested in agriculture when I had been spending most of my summers working on my aunt and uncle's dairy farm in Cape Breton, and both my parents had followed careers in the food and agriculture sector. I realize now that my summers in Cape Breton had a profound impact on me after I made the decision to work in agriculture. During my summers there I saw many family farms fail and the community change.

While working on my degree, I spent much of my free time working with activist and public education groups. We focused primarily on the politics of food production and distribution and although my thesis work was concentrated on the impacts of crop rotations on soil physical properties, I increasingly realized that my original assumptions about underdevelopment were incorrect. My focus on political issues in food production gradually merged with concerns about environmental degradation associated with agriculture. A summer in Pennsylvania working with the Rodale Research Center convinced me that ecological agriculture was a viable solution to agricultural production. By the time my Master's was completed I had decided to work for an environmental group addressing political and ecological questions. I took a job with OPIRG.

I tell you all this to give you an appreciation of who I am and what my assumptions are. These experiences make me believe that we suffer in Canada from a serious imbalance in the control of resources and decision making authority in agriculture and other sectors. I also believe in the power of grassroots citizen movements to affect constructive change in society. Agricultural problems will not be permanently resolved until our production, processing and distribution systems respect local and regional decision making and ecology.

A note on codes

A common challenge in qualitative research is the clear use of codes to identify qualitative data. Such codes are necessary in order to avoid continually repeating the full information contained in each bit of qualitative data. A summary list of codes is provided here for the reader's reference.

A	Agribusiness
C	Case
D	Driving
Fi	Confirming comments
I	Interview
R	Restraining
Rev	Reviewer
S	Research
T	Themes
Tr	Contradicting comment
W	Workshop

Common combinations of codes:

RTA#	Agribusiness Restraining Theme
DCG#	Government Driving Case
W.Le88.S#	Lennoxville workshop comment on research, held in 1988
I.Ze88.A#	Interviewee (Ze) comment on agribusiness, made in 1988
RevTrG#	Contradicting reviewer comment on government

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Publications

The following publications have been produced during the course of this thesis:

Refereed

1. Hill, S.B. and MacRae, R.J. 1988. Developing sustainable agriculture education in Canada. **Agriculture and Human Values** 5(4):92-94.
2. MacRae, R.J., Hill, S.B., Henning, J. and Mehuys, G.R. 1989. Agricultural science and sustainable agriculture: a review of the existing scientific barriers to sustainable food production and possible solutions. **Biological Agriculture and Horticulture** 6:173-219.
3. MacRae, R.J., Hill, S.B., Mehuys, G.R. and Henning, J. 1990. Farm-scale agronomic and economic transition to sustainable agriculture. **Advances in Agronomy** 43:155-198.
4. MacRae, R.J., Hill, S.B., Henning, J. and Bentley, A.J. 1990. Policies, programs and regulations to support the transition to sustainable agriculture in Canada. **American Journal of Alternative Agriculture** 5(2):76-92.

Government reports

1. MacRae, R.J. 1989. Policies, programs and regulations to support the transition from conventional to sustainable agriculture. A report to Agriculture Canada. Ecological Agriculture Projects, Ste-Anne de Bellevue, QC. Sept. 29, 1989.

2. MacRae, R.J., Bentley, A.J. and Hill, S.B. 1989. An overview of the definition, certification, verification and control of organic and natural foods in Canada and with our major trading partners. A report to the CARC ad hoc committee on natural and organic foods. Ecological Agriculture Projects, Ste-Anne de Bellevue, QC. Oct. 31, 1989.

Other research papers

MacRae, R.J., Henning, J. and Hill, S.B. 1988. Financing organic/sustainable agriculture: current problems and new strategies. Ecological Agriculture Projects Research Paper #5. Ecological Agriculture Projects, Ste-Anne de Bellevue, QC.

MacRae, R.J., Henning, J. and Hill, S.B. 1990. Strategies to overcome barriers to the development of sustainable agriculture in Canada: the role of agribusiness. Ecological Agriculture Projects Research Paper #11. Ecological Agriculture Projects, Ste-Anne de Bellevue, QC.

S.B. Hill, G.R. Mehuys and J. Henning were all involved in these papers as thesis supervisors: editing, ensuring clarity of thinking, and identifying sources of information that were not taken into account. The exception was the paper published in **Agriculture and Human Values** with S.B. Hill as the lead author. R.J. MacRae's contribution from his thesis consists of sections page 92, column 1; page 93, first two paragraphs of column 2; page 94, final paragraph of column 2 up to the conclusions. A.J. Bentley was a research assistant for particular aspects of the thesis work, including collating data and organizing references.

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.

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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.

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 considered 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 agroecological 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 been 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 practicing 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 focused their activities initially 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 organizations 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.

Table 1

Indicators of significant governmental and para-governmental agency interest in sustainable agriculture in Canada (as of 1990)

Newfoundland

* Commission of Inquiry into the Future of Newfoundland Agriculture will recommend government support for the development of an organic food sector

Nova Scotia

* Department of Agriculture and Marketing has created a committee to examine the provincial response to the changing agricultural environment

New Brunswick

* has appointed a sustainable agriculture extension agent

Prince Edward Island

* has created a sustainable agriculture section within the agriculture department
* is operating a pilot program supplying subsidies and crop insurance for transitional growers

Québec

* has hired a coordinator within the department of agriculture (Ministère de l'agriculture, des pêcheries et de l'alimentation - MAPAQ)
* has developed a comprehensive plan, valued at $3 million, for training, research, information dissemination, and regulatory support for the term organic in the marketplace (MAPAQ)
* has a network of advisors based in regional MAPAQ offices
* has supplied funds to certification groups and a federation of organic producers (MAPAQ)
* The Conseil de Production Végétale du Québec (CPVQ) and Conseil de Production Animale du Québec (CPAQ) have formed sub-committees on organic agriculture
* Ordre des Agronomes du Québec has identified training needs for its members

Ontario

* Ontario Ministry of Agriculture and Food (OMAF) has prepared an information extension package
* has enacted a Land Stewardship and pesticide use reduction program (OMAF)
* OMAF is supplying funds to an organic certification agency
* OMAF has a joint working group with ecological farming associations to discuss possible government supports for the transition process
* has entered into negotiations with possible funders for the establishment of an organic farming research facility

Manitoba

* funded a comprehensive report on ecological agriculture (1983)
* negotiating with a certification agency regarding the creation of legislated certification standards and verification procedures for organic production

Saskatchewan

* Can-Sask Crop Insurance has an organic farming crop insurance program
* funding economic analyses of organic agriculture

Table 1 (cont.)

British Columbia

* passed "Food Choice and Disclosure Act", enabling legislation for regulating the terms organic, natural and pesticide-free
* funding the development of organic production and processing standards and the development of an evaluation and accreditation process for certification programs

Canada

* Consumer and Corporate Affairs has developed a new definition of organic food
* Environment Canada funded the preparation of a directory of organizations and services in sustainable agriculture
* Environment Canada is integrating sustainable agriculture issues into its comprehensive environmental strategy
* Environment Canada in the Western region has prepared a report
* Energy Mines and Resources has provided funding for sustainable agriculture research
* Agriculture Canada is funding several agronomic and marketing studies on organic agriculture
* Agriculture Canada has created a Sustainable Agriculture Task Force at the deputy ministerial level with a mandate to review how their activities restrain the development of sustainable agriculture
* The Science Council of Canada is undertaking a major study of sustainable agriculture and policy initiatives to support the transition

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), pesticide 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,

Table 2
Gross return data for a variety of crops and products from microeconomic studies of organic and conventional farms in Europe and North America[a]
(adapted from McKinney, 1987; Segal and Golebiowski, 1988)

Crop / Product (Major)	Percent Difference[b]	Location	Reference
Corn, Soybeans, Wheat, Rye Oats, Barley Clover, Alfalfa Cattle, Hogs, Eggs	5.2	Kutztown, PA, USA	Culik et al., 1983
Corn, Soybeans, Oats	43.6	East-Central NB, USA	Sahs et al., 1988
Wheat	10.3	Pacific Northwest, USA	Kraten & Holland, 1978
Corn, Soybeans Wheat	- 2.4	Midwest USA	Lockeretz et al., 1981
Wheat	15.3	Switzerland	Lampkin, 1986b
Barley	7.6	"	"
Small dairy	8.6	"	"
Large dairy+[c]	- 6.2	"	"
Large dairy-[d]	- 24.7	"	"
Winter Wheat	- 12.7	Great Britain	Vine & Bateman, 1981
System I (soybeans, corn, oats, alfalfa, spring wheat)	- 47.4	South Dakota, USA	Dobbs et al., 1988
System II (soybeans, spring wheat, oats, sweet clover, barley)	25.0	"	"

Table 2 (cont.)

Corn, soybean (in rotation with manure)	- 2.5	Pennsylvania, USA	Duffy, 1987
Corn, soybean (in rotation without manure)	-41.4	"	"

[a] These studies have not included financing costs, largely because of the methodological problems involved (Lampkin, 1985b).
[b] Percentage increase/decrease in net return on organic farms relative to conventional farms growing the same crops. Negative numbers indicate a higher conventional net return.
[c] Large dairy operation obtaining premium prices for the milk.
[d] Large dairy operation with no premium prices.

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

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

Table 3
Yield data for a variety of crops and products from microeconomic studies of organic and conventional farms in Europe and North America
(adapted from McKinney, 1987; Segal and Golebiowski, 1988; Stanhill, 1990)

Crop / Product	Percent Difference[a]	Location	Reference
Barley	- 27.8	Kutztown, PA, USA	Culik et al., 1983
Oats	2.8		
Rye	- 7.6		
Wheat	- 3.2		
Oats	36.2	Corn Belt, USA	Roberts et al., 1979
Wheat	0.0		
Wheat	- 42.7	Midwest, USA	Lockeretz et al., 1981
Spring Wheat	4.9	Sweden	Pettersson, 1978
Barley	- 5.5		
Winter Wheat	- 29.3	Washington, USA	Patten, 1982
Spring Wheat	88.3		
Winter Wheat	9.8	West Germany	Lampkin, 1986a
Spring Wheat	0.0		
Winter Barley	- 2.3		
Spring Barley	- 8.3		
Oats	5.4		
Potatoes	0.0		
Wheat	- 13.3	Switzerland	Lampkin, 1986b
Oats	- 16.0		
Barley	- 13.3		
Maize	- 6.4		
Milk (l/cow)	- 11.6		
Winter Wheat	- 17.0	Great Britain	Vine & Bateman, 1981
Winter Wheat (av. 1950-81)	- 3.81	Washington, USA	Bolton et al., 1985

Table 3 (cont.)

Corn	- 8.5	S. Dakota, USA	Dobbs et al., 1988
Soybeans	- 6.7		
Spring Wheat	- 4.8		
Corn	- 7.1	East-Central Nebraska, USA	Helmers et al., 1986
Soybeans	- 10.1		
Oats	5.4		
Wheat	-31.5	Germany	Grimm, 1988
Rye	-27.8		
Potatoes	-32.6		
Milk	-15.1		
Dry beans	16.6	Maine, USA	Eggert, 1983
Carrots	5.2		
Tomatoes	4.2		
Potatoes	-24.8	Uppsala, Sweden	Dlouhy, 1981
Wheat	-11.8		
Barley	-21.8		
Corn	-11.0	Kutztown, PA, USA	Liebhardt et al., 1989
Soybean	5.6		
Beans	-17.8	Koln, Germany	Lindner, 1987
Cabbage	-33.2		
Cauliflower	-36.3		
Lettuce	-23.7		
Spinach	-34.8		
Wheat	-16.6	Suffolk, UK	Balfour, 1975 Stanhill, 1990
Barley	-16.5		
Beans	-16.0		
Milk	6.2		
Eggs	-15.4		

[a] Percentage increase/decrease in yield on organic farms relative to conventional farms growing the same crops or products. Negative numbers indicate a higher conventional yield.

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, farmèrs 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 turn-over 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

Table 4

Principles ("laws") of nature in relation to food production and institutional response *

"Law" of Nature	Some Contraventions: Our Food System	Some Contraventions: Institutional Process
1. Survival is based on: Needs (food, space, shelter, clothing, education and other quality of life factors)	Much of our system is geared to supplying not real, but manipulated needs (e g. no real need in Canada for refined sugar, coffee, Florida citrus)	Value systems that are rooted in wants vs ecological realities (e g high salary, powerful equipment fueled with non-renewable resources)
Availability of the resources on which these needs depend.	Every stage of food production and subsequent handling is dependent on non-renewable resource inputs (particularly fossil fuels).	Use of analytical tools that employ a short time frame and discount issues of non-renewability
The incidence of mortality factors	Additional health hazards have been created with the industrialization of agriculture, e.g. machines and toxic chemicals.	"Rewards" for finding solutions to problems by using products implicated as mortality factors.
2. Some key relationships in the environment are cyclical.	The system is characterized by linear nutrient flows with their associated dependence on non-renewable resources and resultant pollution.	Linear, hierarchical decision-making systems without adequate evaluative feedback loops. Organizational paralysis due to "infoglut"
3. Limits exist within the environment which, if not respected, result in its degradation.	Inability of environment to degrade novel chemicals rapidly without poisoning many organisms. Harvesting beyond replacement.	Use of high-powered technologies that transcend limits Focus on marketable products that can be used irrespective time and space.
4. Over time, ecosystems tend to increase in complexity, reliance, and in the functional diversity of their species. Although competition, strife, conflict and parasitism exist in nature, evolution usually depends more on cooperation and sybiotic relationships.	An increasingly complex tecnnology is used to manage more simplified ecosystems, e.g , - reduced gene pool - monocultures - removal of competitors - creation of uniform soil conditions - removal of "non-productive" areas such as hedgerows, wetlands, woodlots Solutions to problems deal primarily with symptons	Designing away variability by simplifying data collection and analysis (e g a commodity based development strategy) Single disciplinary teams working in isolation Centralized control of decision making
5. Most processes are non-linear and exhibit threshold responses, often with rapid transformation to a complex form with new linkages.	Failing to act on early signs of nitrate accummulation in acquifers. Skyrocketing unpaid costs of environmental clean-up.	Incremental steps toward change. Faliure to recognize early warning indicators and causes of problems. Crisis management.
6. Natural ecosystems exhibit numerous benign self-maintaining and self-regulating processes that if interfered with result in degeneration and dramatic population fluctuations	Application of highly soluble N inhibits symbiotic N-fixers. Pesticides kill natural controls Boom and bust cycles in certain commodities.	Operating procedures that demotivate employees resulting in high turnover and lack of commitment. Overspending the capital base of the organization.

*** (adapted from Hill, 1982, 1988; Walters and Holling, 1984; Dryzek, 1987; Wrabley, 1989)**

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).

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 substitution 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.

Figure 1
Schools of thought in sustainable agriculture arranged according to an efficiency-substitution-redesign framework

LOW Sustainability

Schools of thought	Characterized by:
Conventional [Monoculture] ↓ [Minimum tillage, chemical banding]	External Solutions to internal problems: emphasis on compartmentalization, and control, single, simple, direct short-term physico-chemical, imported curative solutions to local problems **Efficiency:** reduced inputs and waste
LISA[a] Lemaire-Boucher[b,l] Ecoagriculture[c,l]	**Substitution:** of benign inputs
Regenerative[d,l] Organic[e,l] Biological[f,l] Biodynamic[g,l] Ecological[h,l] Permaculture[i] Bioregionalism[j] Natural[k]	**Benign Design** and management Internal solutions to internal problems: emphasis on integration, balance, and response to feedback, complex, indirect, long-term, bioecological, local approaches to solving both local and global problems

HIGH Sustainability

Defined and described by:

[a] Edwards, 1987
[b] Aubert, 1972
[c] Walters and Fenzau, 1979
[d] Brusko et al , 1985
[e] Howard, 1947; Balfour, 1975
[f] Hodges, 1982
[g] Koepf et al., 1976
[h] Hill, 1985a
[i] Mollison, 1979
[j] Sale, 1985
[k] Fukuoka, 1985
[l] Products are often sold using an organic food label

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).

Figure 2
Example of progressive integration of a new design into a farm in transition (adapted from Zerger, 1984)

Transition Year	Field 1a	Field 1b	Field 2a	Field 2b	Field 3a	Field 3b
0	Winter barley Green manure	Winter barley Green manure	Winter wheat	Winter wheat	Sugar beets	Sugar beets
1	Sugar beets	Sugar beets	Winter barley Green manure	Winter barley Green manure	Winter wheat	Winter wheat
2	Winter wheat	Winter wheat	Sugar beets	Sugar beets	Winter barley Green manure	Winter barley Green manure
3	Red clover	Field beans Green manure	Winter wheat Green manure	Winter wheat	Sugar beets	Sugar beets
4	Winter wheat Green manure	Potatoes	Field beans Green manure	Red clover	Winter wheat	Winter wheat
5	Field beans Green manure	Winter wheat	Potatoes	Winter wheat Green manure	Red clover	Rye
6	Potatoes	Rye	Winter wheat	Field beans Green manure	Winter wheat Green manure	Red clover
7	Winter wheat	Red clover	Rye	Potatoes	Field beans Green manure	Winter wheat Green manure

Underlining indicates that the transition has begun on the field
Double underlining indicates that the transition is completed

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

Table 5

Rules for designing an effective transition rotation

(adapted from Vogtmann et al., 1986)

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1. Deep-rooted crops should follow shallow-rooting crops -- helps keep soil structure open and assists drainage.
2. Alternate between crops with high and low root biomass -- high root biomass, especially pasture grasses, provides beneficial soil organisms, such as earthworms, with food.
3. Nitrogen fixing crops should alternate with high N-demand crops -- aim to meet all of the farm's N requirements from within the system.
4. Slow growing crops, which are more susceptible to weed invasion, should follow weed suppressing crops.
5. Where risks of disease or soil-borne pest problems exist, potential host crops should only occur in the rotation at appropriate time intervals (e.g., brassicas, potatoes).
6. Catch crops, green manures and undersowing techniques should be used, whenever possible, to keep the soil covered -- reduces erosion and nutrient leaching, particularly in winter.
7. Consider also:
   * suitability of individual crops with respect to climate, soil, and other local environmental conditions;
   * balance between cash and forage crops;
   * seasonal labour requirements and availability;
   * cultivation and tillage operations;
   * local market conditions.

Table 6

Selection of rotation crop in relation to preceding crop

(adapted from Ripley, 1941; Vogtmann et al., 1986)

	Preceding Crop										
Following Crop	wh	wb	sb	r	oa	m	pe	al	pas	p	be
Winter wheat (wh)	-	-	-	+	+	+	*	+	+	*	+
Spring wheat (wh)	-	-	-	+	+	*	(*)	+	+	*	*
Winter barley (wb)	+	-	-	+	+	-	*	+	+	-	-
Spring barley (sb)	+	-	+	+	+	*	o	-	+	*	*
Winter rye (r)	+	+	+	+	+	+	*	+	+	+	o
Spring rye (r)	+	+	+	+	+	*	(*)	*	*	*	*
Oats (oa)	+	+	+	+	o	*	*	*	*	*	*
Maize (m)	*	*	*	*	*	o	*	*	*	*	*
Peas (pe)	*	(*)	*	*	*	*	-	-	*	*	*
Alfalfa (al)	(*)	+	*	*	+	+	-	-	-	*	*
Pasture (pas)	+	+	*	*	*	+	*	+	+	*	*
Potatoes (p)	*	(*)	*	*	+	*	*	*	*	o	*
Beets (be)	*	*	*	*	*	*	*	*	*	*	-

* Good.

(*) Good, but unnecessary. Other crops make better use of the preceding one. Could be used in combination with catch crop or green manure.

\+ Possible.

o Limited applications, i.e.; not possible if preceding crop harvested late, in dry areas, if pest risk exists (mainly nematodes), or if danger of lodging (e.g., spring barley after legumes).

\- Bad or impossible.

Table 7

Example of a rotation nitrogen budget developed for a transition plan

(adapted from Lampkin, 1985a)

Year	Crops in rotation	N-budget +	N-budget -
		----- kg/ha	---
1	Alfalfa or grass/white clover pasture	200	130
2	Alfalfa or grass/white clover pasture	200	130
3	Winter wheat	-	120
4	Winter oats	-	100
	undersown with annual legume		
	(e.g., trefoil as a green manure)	100	-
5	Spring beans	150	150
	mustard/rape as a green manure	-	-
6	Winter wheat	-	120
7	Winter rye	-	100
	undersown with alfalfa or grass/clover		
	mixture	75	-
		-----	-----
Total		+725	-850

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

Figure 3
Nitrogen cycling in a cereal field on an egg-producing farm converting from conventional to sustainable agriculture
(Patriquin, 1984)

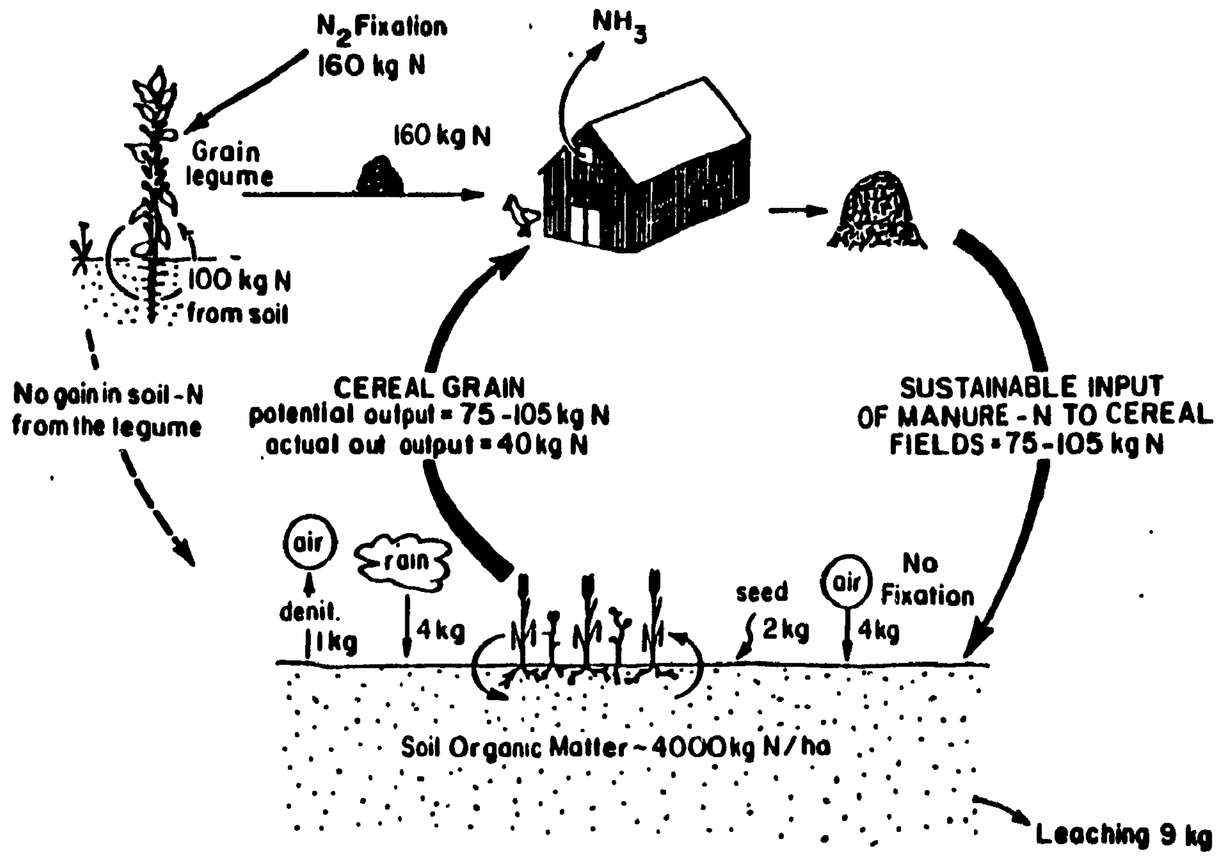

Table 8

Common tillage practices in sustainable agriculture

(Schriefer, 1984; Vogtmann et al., 1986; Little, 1987)

System	Some Common Practices
Minimum tillage	Chisel plowing
	Disc harrowing
	Overseeding
	Two-layer plowing[a]
No-till without chemicals	Aerial seeding
	Drilling into previous crop
	Overseeding
Ridge tillage	Ridging
	Planting on ridges
	Chisel plowing[b]
	Disc harrowing[b]
Ro-till	Planting with in-row chisel tillage
Contour tillage	Variety of tillage practices[c]

[a] A plow manufactured in Germany that does not bring lower soil layers to the surface or invert the top layer.

[b] Unnecessary in many ridge tillage systems.

[c] A variation on contour tillage for dryland areas called the "Keyline Plan" was developed by Yeomans (1978).

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

Table 9
Negative environment consequences of synthetic chemical use and monoculture cropping
(adapted from Hodges and Schofield, 1983)

Increased incidence of pest and disease problems
Development of resistance in pests, diseases, and secondary pests
Reduced animal resistance to disease (confinement, poor ventilation, sub-therapeutic antibiotics)
Reduced genetic diversity in plants and animals
Reduced seed germination and cattle fertility
Soil and plant nutritional imbalances
Reduced soil organic matter levels and increased erosion
Negative effects on beneficial soil organisms, natural pest control and wildlife
Poisoning of animals and humans (lead, pesticides, nitrates)
Polluted drinking water
Reduced food quality

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, 1937), and some bankers now feel safer lending to farmers with more than cne 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, 1?35; Helmers et al., 1986; Hanson et al., 1990)[3]. Risk reduction will become increasingly im-

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3. 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.

portant 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 declina 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).

2.7 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.

3.0 Methodology

A study of this kind, with its focus on holistic analysis and synthesis, is in need of a different methodological approach from most studies in agriculture. It is a study that relies, in the absence of physical testing and analysis, almost entirely on the intellectual and conceptual resources of the investigator, and on conceptual tools to ensure rigour, validity and accuracy. The methodology must account for the evolution and conclusions of the study. The first part of this section describes the limitations, for the purpose of this work, of the conventional concepts of knowledge, inquiry, scientific method and practice, and outlines the evolving contemporary ideas of knowledge and knowing. The second part (3.2) provides general information on a specific tool, consistent with these evolving ideas, that was used. The details of the method of this study are presented in part 3 (3.3), and techniques for ensuring the validity of the method are provided in part 4 (3.4).

3.1 The nature of knowledge

Most scientific and economic thinking and method is dominated by the positivist, reductionist tradition that has its roots in the works of René Descartes and Francis Bacon and the socio-economic conditions of their times. Some of the basic concepts of this tradition are that:

* Science is a linear progression from ignorance to proven knowledge (Sattler, 1986).

* A phenomenon can be isolated from its context and studied in parts and these parts can then be reassembled to make sense of the whole phenomenon (Busch and Lacy, 1983; Miller, 1985a).

* Knowledge is separated into two main aspects: the physical or material, which is for scientific examination, and the spiritual, which is in the realm of religion, mysticism and nonsense (Bahm, 1979; Capra, 1982; Weber, 1986).

* There is one reality that can be known objectively and objectivity is possible and desirable. Knowledge is identical for all knowers (Reason and Heron, 1986).

* To understand a phenomenon is to describe the mechanism that produces it, which requires a numerical model. Numerical models demand certainty, stability and boundaries, and this requires that related phenomena be excluded. The primary goal of developing such models is prediction (Harré, 1981).

* Explanation occurs by establishing singular cause and effect relationships (Reason and Heron, 1986).

* Science is a body of absolute knowledge that is distinguished from non-science in the same way as sense is distinguished from non-sense (Randall, 1986).

These concepts (among others) are part of the foundation on which current methods of agricultural research are based, as evidenced in the following characteristics of the agricultural research process.

* Laboratory and small field plot work, computer modelling and simulations are the normal process of inquiry in order to control the experiments. Althoug the models may be internally logical and scientific,

they often are unrealistic (Hillel, 1987). For example, the General Flow Equation (D'Arcy's Law) is the foundation of water flow models in soil. It has 11 major assumptions which only rarely all apply to a given soil, yet it is used within the disciplines of soil physics and agricultural engineering as if the model provided an accurate description of soil conditions. The problem with such an approach is that the assumptions necessary for the development of the model usually severely constrain its application. This is rarely stated and often forgotten.

* Most studies do not adequately consider the whole system level, but rather focus on lower levels of inquiry from the sub-cellular, to the plant or animal part, or soil sample. Data from these levels of experimentation are often used to predict, usually unsuccessfully, what may happen at the system level (Georgescu-Röegen, 1971; Loehle, 1988).

* Most factors are controlled while the investigator examines one or a few variables. Examination of so few variables makes it extremely difficult to understand the whole. Attempts to synthesize information assembled in this way have met with limited success (Hanway, 1978; Busch and Lacy, 1983).

* Some variables are assumed to be dependent, others independent. The dependent variable is affected or controlled by the independent one (a deterministic model).

* Results are rarely tested in the "real" world. Instead the "real" world (the field test) is modified to resemble the laboratory (Busch, 1984; Jackson, 1984).

* Investigators assume that they are objective if they follow set experimental procedures that the discipline has deemed acceptable. As-

sumptions of methodologies and previous literature are rarely examined to see if they are still relevant (Kuhn, 1970).

* There is little reflection on the relationship between scientific method and the philosophy, values and socio-economic conditions associated with the way humans discover knowledge (Mahoney, 1976).

* If an effect or relationship can not be observed or explained using these procedures, then it is often assumed that none exists. Knowledge generated by other procedures (experience, intuition) is considered to be unreliable.

* Phenomena are not examined as "real" but as objects, usually described two dimensionally with mathematics (reification). Statistics are used extensively, especially to justify conclusions and assist in prediction.

Given the multidisciplinary nature of this study, these approaches are too limiting. They are not designed to explain phenomena at a "higher" (i.e., integrated, systemic) level (Loehle, 1988)[4]. The methods employed in this study are rooted in the new emerging paradigms that take a different view of the nature of knowledge, and of the role of science in discovery.

New paradigm research combines the propositional knowledge of old paradigm research and the experiential and practical knowledge of naive inquiry to create a critical, objectively subjective process of inquiry (Fig. 4). An objectively subjective inquiry employs a reasoned,

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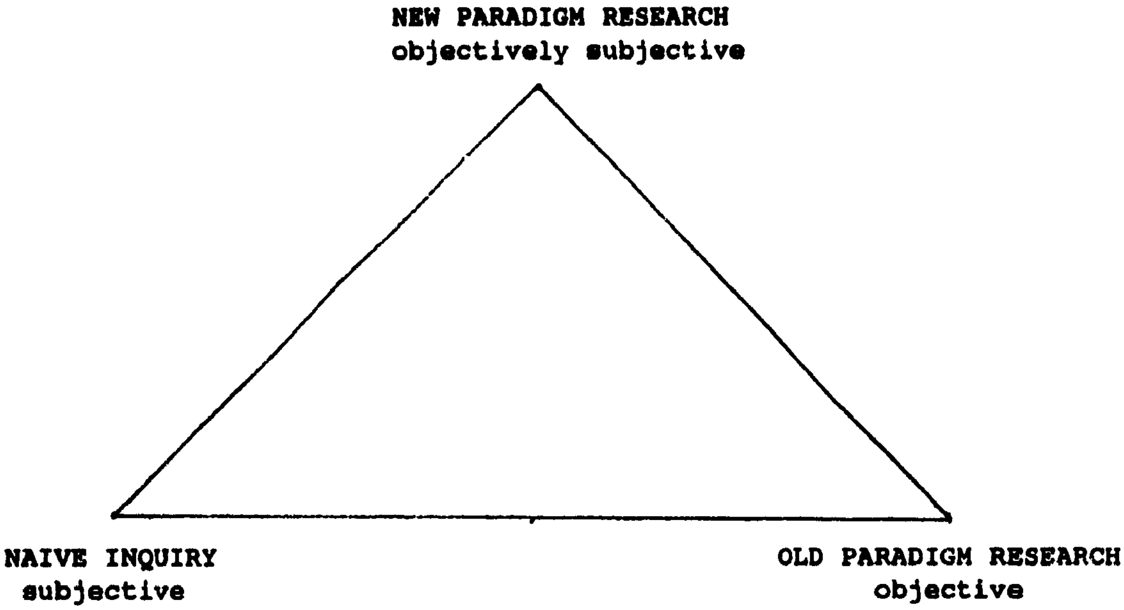
4. Another way of looking at the differences between conventional and emerging paradigms is to focus on the difference between quantitative and qualitative approaches. Rigorous methods of qualitative data analysis have been, until recently, largely ignored (Miles and Huberman, 1984).

Figure 4
The relationship between new and old paradigm research
(Reason and Rowan, 1981c)



consistent, patterned investigation and discourse, while acknowledging that the nature of the investigative procedures subjectively influences the results. Epistomologists argue that all knowledge is not absolute, but relative and partial, and that our best attempts to understand can only qualify as warranted conjecture (Mahoney, 1976). Social and psychological factors play an important role in scientific practice and knowing. In studying biological systems, then, knowledge is a result of a dynamic interaction between the values embedded in one's procedures for knowing[5], the biological system being examined, the social organization of the people involved with that system, and the technologies employed (Fig. 5).

What are the characteristics of a science based on these emerging concepts?

* Science is a process of critically reasoned discourse (Randall, 1986). Using this definition, the distinction between the so-called "hard" and "soft" sciences becomes arbitrary since all disciplines employ such a definition, although specific methods vary. A key barrier to interdisciplinary investigation is removed when science is no longer seen as a body of fact or knowledge, but rather as a process of, or tool for, inquiry.

* The investigator is engaged in a process of discovery of meaning, which does not necessarily include the creation of predictable knowledge (Bortolt, 1986). Discovery involves a search for unifying concepts (Weber, 1986; Jackson, 1987). This is exemplified by Lovelock's (1979)

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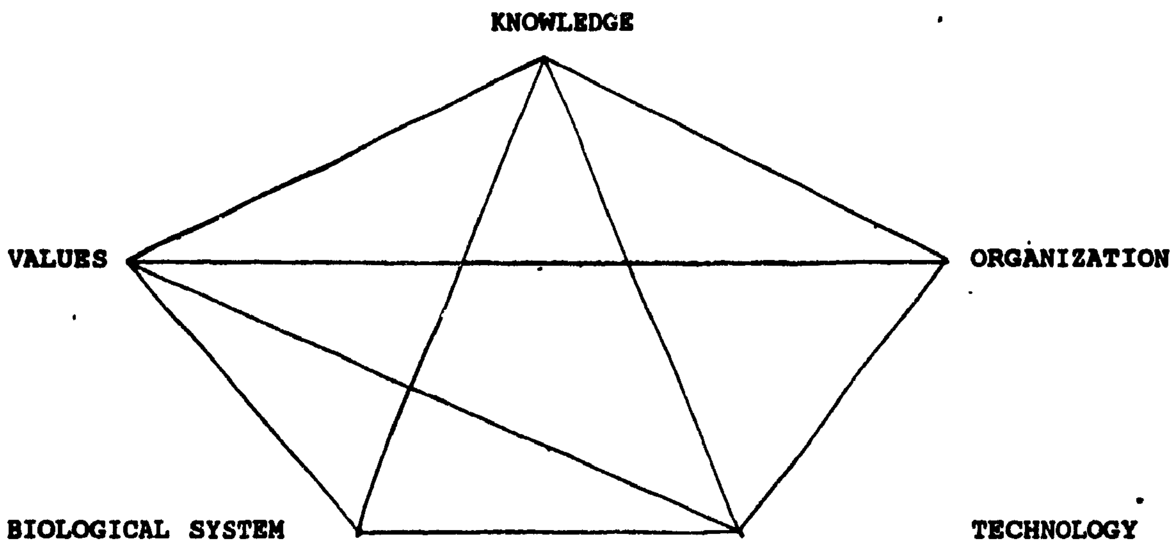
5. See Appendix 1 for a discussion of the psychological factors that can affect a scientist's values and investigative procedures, and techniques for ensuring that such factors are not destructive to the investigation.

Figure 5
Factors that affect knowledge
(Norgaard, 1987)



Gaia hypothesis; that the earth functions in similar ways to an organism. Such a concept is not explicitly testable but is validated by its explanatory power (or "network of interrelated ideas and evidence that together have . . . validity" [Reason and Heron, 1986:467]). In this particular case, Lovelock's hypothesis suggests an explanation for many poorly understood global biological and climatological processes. Although now in part discredited (cf. Sheldrake, 1981; Levins and Lewontin, 1985), Darwin's theory of evolution through natural selection was a unifying concept for many decades.

* The process of inquiry takes place simultaneously at a number of levels, the small to the large, and this does not necessarily place undue burden on the investigation. "It is an often overlooked fact that other attributes become less complex and less variable as we go from the small to the large unit...and a certain amount of integration occurs as smaller units function" (Odum, 1971:51). Using water as an analogy, we do not have to know everything about the behaviour of hydrogen and oxygen (the lower, disaggregated level) to understand many of the properties of water (the higher, integrated level). Even knowing everything about the properties of these elements will not help us predict everything about the behaviour of water (Dryzek, 1987). At the higher synthetic level, one is concerned with more global perceptions, interactions, goals and action (Table 10). This higher, integrated level requires a type of scientific inquiry that is quite different from investigating a human cell, for example (Harman, 1988). Sustainability is a high level concept.

* The investigator and his/her procedures are not separate from the investigation (Bortolt, 1986). The values embedded in the investigative procedure, whether originating from the individual or the institutional

Table 10
Characteristics of inquiry at a synthetic level
(adapted from de Rosnay, 1979)

The investigative process strives to:

1. Unify and concentrate on the interactions between elements

2. Study the effects of interactions

3. Emphasize global perception

4. Modify groups of variables simultaneously

5. Integrate duration of time and irreversibility

6. Validate facts through comparison of model behaviour with reality

7. Use models that are insufficiently rigourous to be used as the basis of knowledge (in an old paradigm sense) but are useful in decision and action

8. Have an efficient approach when interactions are non-linear and strong

9. Lead to multidisciplinary education

10. Lead to action through objectives

11. Possess knowledge of goals, but is fuzzy on details

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environment of the investigator, always have a dynamic relationship with the investigation in that values influence the choice of problem to study and the interpretation of what is experienced, and the investigation, in turn, influences values as new knowledge is acquired. Rather than striving to be objective, a valid investigative process should aim to clarify all assumptions or expectations. What the investigator seeks is a state of critical subjectivity (Reason and Heron, 1986), or what Buddhist scientists call "non-attachment" to preconceived ideas (Harman, 1988). "It should be noted that one does not begin the research with full awareness of one's structure of prejudice or prejudgements, but that it's in the course of the interpretative process that these gradually become clearer" (Groome, 1987:58).

* The investigation should provide a greater understanding of a greater number of problems (Kuhn, 1970). The study should contribute to our breadth of understanding, not isolate it. The method strives for completeness (Bahm, 1979; Jackson, 1984).

Given these characteristics, a useful conceptual model or theoretical framework (Cunningham, 1986):

* must have generality and encompass as many events as possible.
* must have the power to guide action.
* must be simple.
* recognizes that events and situations are connected.
* recognizes multifactor causation.
* has a multilevel structure, distinguishable but not separate from the environment.

The methodology for this study is rooted in this emerging new knowledge paradigm.

3.1.1 The action research framework

A corollary of rejecting the idea that the investigator can be totally separate from the investigation is the notion that an investigation can be designed to meet the needs of a community of people who have a problem that needs solving. The reductionist, positivist paradigm is committed to maintaining a distance between the investigator, the subject being investigated, and the people, objects or events affected by the subject being investigated, which often leads to a dilution of the utility of the results. If such distance is deemed an artificial construction, then the investigator and, for example, a community can be involved in all aspects of the development and implementation of a research project (see Section 3.4 for some caveats). This approach, known by several names including action or participatory research and cooperative inquiry, has grown in use in agriculture in the past few years, particularly in the developing world (cf. Altieri and Anderson, 1986; Patriquin, 1989; Altieri, 1990). Characteristics of this approach are presented in Table 11. In particular, this process is categorized by a cyclical investigation that begins with analysis, then fact finding, conceptualization, planning, execution, more fact finding, and then returns to analysis (Sanford, 1981).

There exists an active sustainable agriculture movement in Canada, in which I am an active participant. A loose coalition of organizations are promoting the development of sustainable systems by engaging in public

Table 11

Characteristics of participatory research in an agricultural context

(adapted from Hall, 1981)

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1. The problem originates in the community or farm itself.
2. The ultimate goal of the research is fundamental structural transformation of the agricultural process and the improvement of the lives of those involved. The beneficiaries are the people concerned.
3. Participatory research involves the people on the farm or the community in the control of the entire process of the research, from problem formulation to dissemination of the results.
4. The focus of participatory research is often on work with a wide range of exploited or oppressed groups; small farmers, farmworkers, indigenous peoples, women.
5. Central to participatory reserach is its role of strengthening the awareness in people of their own abilities and resources, the resources of the farm and community, and its support to mobilizing or organizing.
6. The term 'researcher' can refer to both the community or farmers involved as well as those with specialized training.
7. Although those with specialized knowledge/training often come from outside the situation, they are committed participants and learners in a process that leads to involvement rather than detachment.

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education, lobbying and public interest research. My involvement in all these activities has been critical to the conception and evolution of this research project. Other participants in this movement have made critical contributions to its implementation by providing data and analysis. The results of the project are targeted to this movement to assist it in the process of promoting sustainable agriculture in Canada.

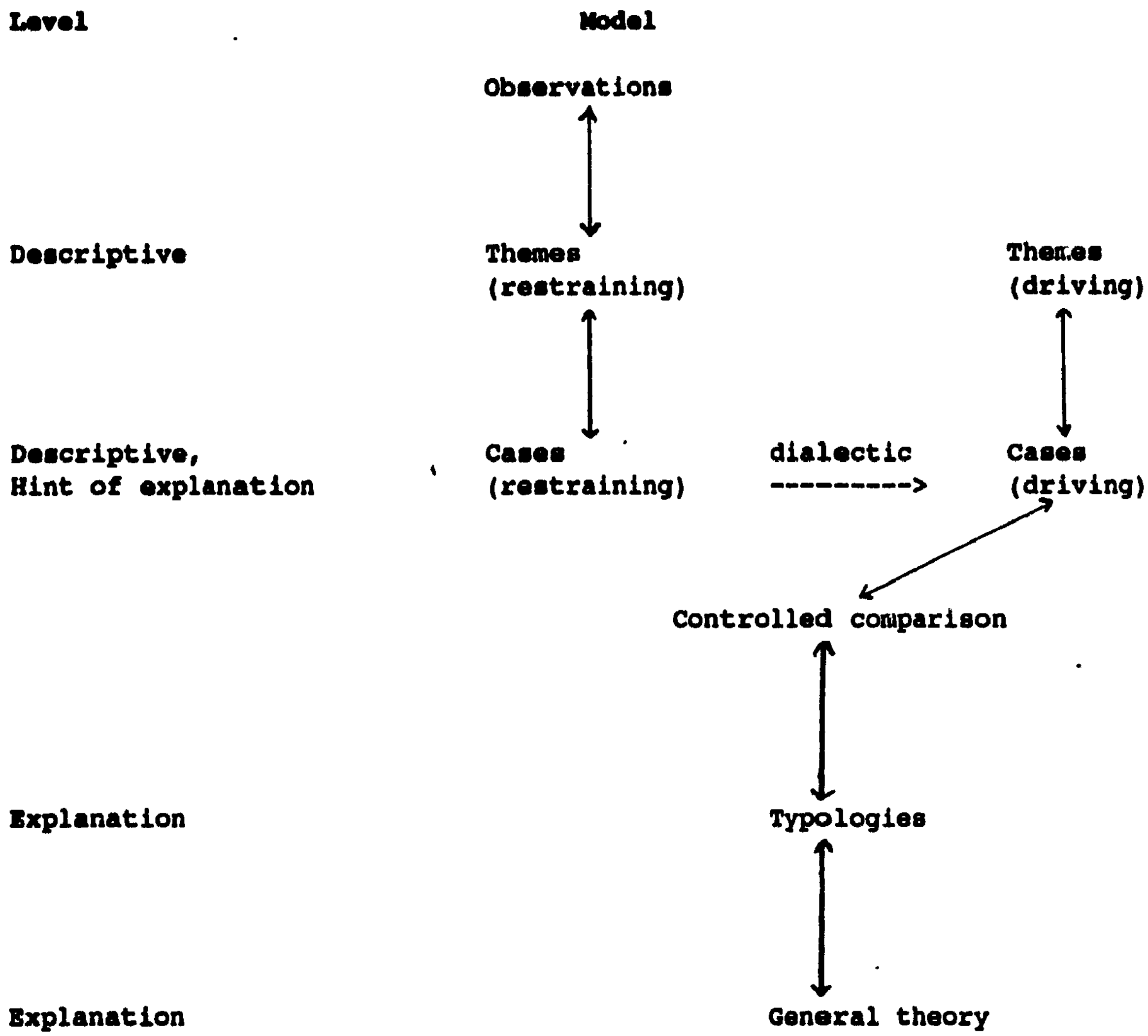
3.2 The pattern model method

This project is as much concerned with method as it is about content. As disciplines, agroecology and ecology are still evolving a critical reasoned discourse (Norgaard, 1987; Loehle, 1988). Consequently, the method for this study is supplemented with methodological reading from many disciplines including communication theory (cf. Habermas, 1971), psychology and social sciences (cf. Reason and Rowan, 1981a) and participatory research (cf. Hall, 1981). A recent report from Environment Canada on the impacts of toxic chemicals on human health has also provided some direction (Muir and Sudar, 1987). The authors wrote about their study, "This report is not a conventional scientific study in the usual sense of the term. We did not begin with a hypothesis, carry out experiments, and report our results. Our starting point was the observation stage, where what we were observing were the results of many scientific studies done by others. We have attempted to integrate and interpret, from our perspective, a diverse array of facts on toxic chemicals and ecosystems and we have ended up with a general hypothesis that the two are connected". Their study draws upon the disciplines of physics, chemistry, biology, ecology, biochemistry, toxicology and economics, disciplines in which the authors admit to being novices, yet the study is very valuable for its attempt to integrate information from all of these areas. The present study takes a similar approach, using observation to develop an explanatory scheme (general hypothesis or theory) that may guide further investigation.

The emphasis is on looking at sustainable agriculture primarily from a "higher", systemic level. Lowrance et al. (1986) describe four levels at which sustainability in agriculture must be considered. Constraints to sustainability operate at field scale, at the level of the farm, on a watershed or landscape system level, and at a national or regional level. The emphasis in this study lies primarily in the final category, but uses information from the other levels to understand what is important at a higher systemic level.

Although there is some literature relating to these higher levels, much of it is concerned with phenomena below the field level. To make sense of this "disaggregated" literature and assess its relevance to sustainability in agriculture, a reflective process of literature analysis was performed using Paul Diesing's (1972) pattern model for inspiration, but considerably modified to meet the needs of this study and some of the more recent thinking reflected in the earlier discussion (Fig. 6). A recognized academic methodology used principally in the social sciences and psychology (cf. Reason and Rowan, 1981a; Lincoln and Guba, 1985; Allender, 1987), the strength of this approach is that it permits the researcher to explain relations between important phenomena, and to develop a many-sided complex picture of these phenomena and their interrelationships. With this approach, validity of the scheme (or general

Figure 6
The revised pattern model method
(adapted from Diesing, 1972)



theory) produced is tested by its explanatory power[6] (i.e., the clarity and coherence of the argument), rather than direct testing (i.e., the standard analytical techniques used in dominant scientific approaches). The scheme changes as new data become available; so the process of investigation is actually rarely finished. In this approach description is emphasized over prediction (the phenomenon approach), the perception of patterns over discovery of bits of information, and holistic synthesis over logical construction.

With this method, studies begin with observation. In the observation phase, the investigator is looking for themes, or patterns. "The human mind finds patterns so quickly and easily that it needs no how-to advice. Patterns just happen...." (Miles and Huberman, 1984:216). de Bono (1967:30) has stated that . . . "The use of patterns provided by experience is the most rapid way of solving problems". "Patterns allow us to make sense of a complex world and, if desirable, to act upon it." (Wright, 1989). These themes are created quite rapidly and the investigator then looks for information to confirm or falsify the initial themes discovered. As themes evolve, new observations may be made that contradict initial themes and result in changes. The discovery of a new theme, in turn, can result in new observations and perceptions. It is this dynamic interaction between themes and observations that ensures falsification of invalid conclusions. At this level, the themes are testable by their concurrence with the data; they may also be checked against reviewers' reactions to the themes, a technique used extensively in this study (see Section 3.3 for details).

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6. This approach is often taken in science without it being acknowledged as such, e.g., Chatelin (1979) in soil science.

Cases are discovered in the same way as themes. A case is a grouping of a number of observations (themes) in a descriptive way that provides a hint of explanation of the grouped observations. Cases are created by seeking relationships between themes, such as causal relationships (or cause and effect), functional relationships (one as a function of the other), relations between a symptom and its sources, and means and ends relationships. In addition to the methods described above for confirmation or falsification, Miles and Huberman (1984) suggest three other techniques: initial statements about relationships can be reversed to see if they then appear more true; researchers can ask themselves what evidence they would need to falsify relationships they think they have discovered; and additional relationships that might be connected can be sought deliberately before deciding on the nature of the relationships being considered. This kind of conceptual testing allows for critical reflection, reflection that does not identify the right answer, but instead identifies a satisfactory direction amongst a range of alternatives (Wright, 1983).

A major modification to Diesing's work is the use of Force Field Analysis (FFA) to categorize cases. Lewin (1947) developed this conceptual tool to assist investigators in their efforts to separate out the different elements affecting change. For the purposes of this study, a restraining case is one that blocks or restrains a desired development. A driving case is one that promotes or drives events towards a desired development (Fig. 7). Restraining cases were identified first as part of the reflective literature analysis, and then driving cases were identified dialectically from restraining ones (Fig. 6).

Figure 7
The force field analysis model
(adapted from Lewin, 1947)

Driving forces (helping factors)	A	Restraining forces (hindering factors)	B
---------------------->	|	<----------------------	|
---------------------->	|	<----------------------	|
---------------------->	|	<----------------------	|
	Present food system		Sustainable food system

----------------------------->
C desired direction of change

In the diagram, A represents the present food system, or that which we wish to change; to B, the sustainable food system. The arrows to the left of A represent forces or factors that can help move us toward B. The arrows to the right of A represent forces or factors that hinder or inhibit the achievement of B. Change occurs when helping factors are maximized or introduced and hindering factors are minimized or removed. C represents the desired direction of change.

To move beyond patterns to the level of explanation requires the development of typologies that evolve from driving cases by the use of controlled comparisons[7]. "Controlled" refers to the degree of similarity of the cases being compared. There needs to be a distribution of clustered similar cases (type being a group of cases that are basically similar and typology being a set of types [Fig.8]). In the early stages of this process, similar cases, and the preliminary concepts that explain their similarity, are used to try to explain phenomena and give the investigator ideas about the cases being analyzed.

These controlled comparisons arise from three sources in the study:

a) The different institutional areas selected for examination. In many instances, the cases developed in each institutional area have common features that can be compared to shed further light on relationships.

b) Deceptive simplicity, confusing complexity, profound simplicity categories. Schultz (1979) has coined the terms "deceptively simple", "confusingly complex" and "profoundly simple" to describe the three stages of perception commonly experienced by individuals and institutions in their attempts to understand phenomena. Hill (unpublished) has modified these three stages for agriculture (Table 12). In the deceptive simplicity stage, one feels that events are readily explained and commonly looks for single, simple relationships between events, relies on experts, focuses on the short term, and fails to recognize essential information. In the confusing complexity stage, there seems to be too much conflicting

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7. Comparison, or the "method of differences", is as old an investigative technique as Aristotle (Miles and Huberman, 1984). Because of the scope and nature of a study of this kind it is very difficult to have a statistically random survey. This process of controlled comparison to create typologies is a means to assess representativeness (Diesing, 1972).

Figure 8
The organization of cases, types and typologies for controlled comparisons

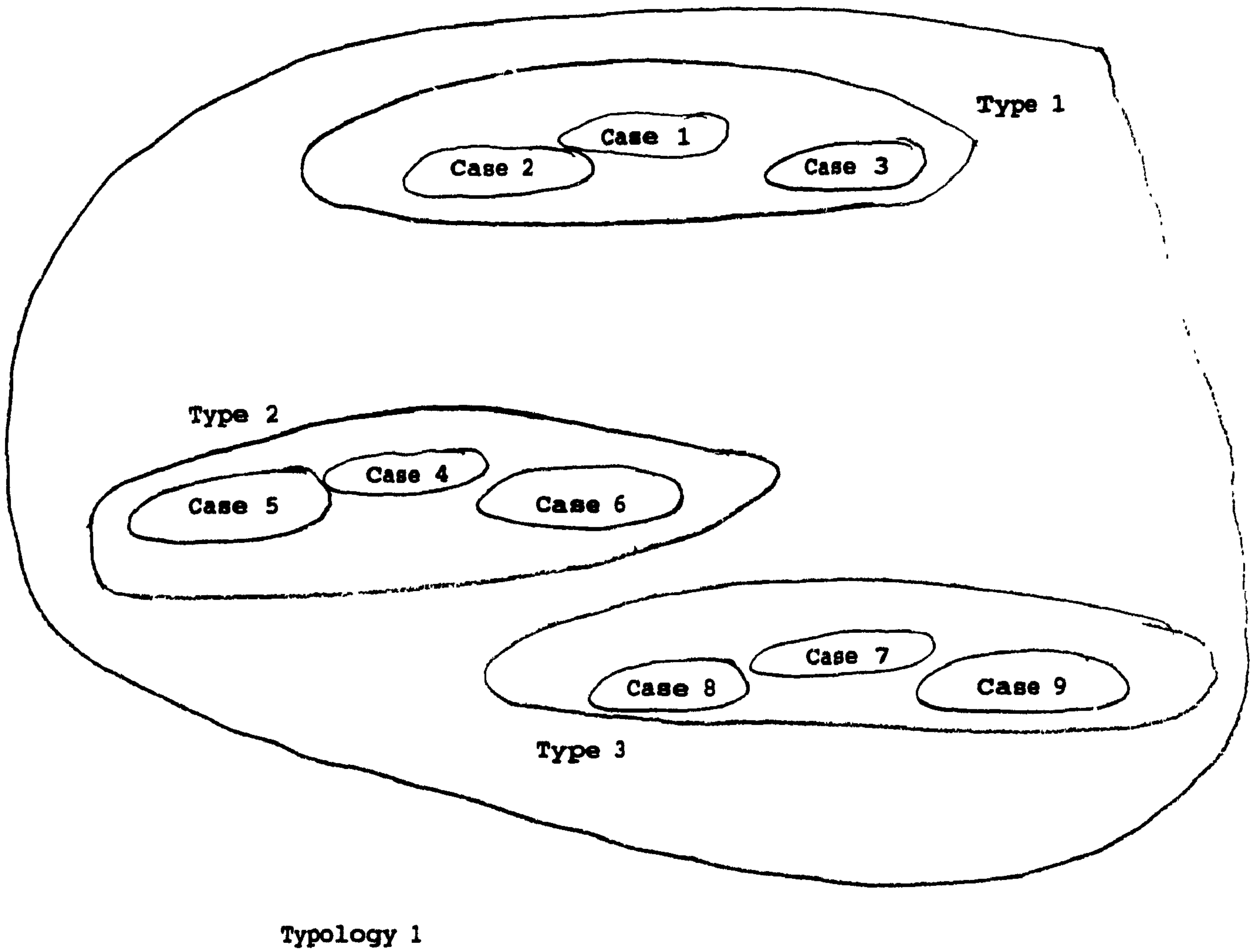

Table 12
Characteristics of deceptive simplicity, confusing complexity and profound simplicity in agriculture
(adapted from Hill, unpublished)

Deceptive simplicity	Confusing complexity	Profound simplicity
External solutions to internal problems Curative, symptom sensitive, enemy oriented Imported, simple, single, powerful, direct, magic bullet solutions Heavy handed controls, regulations, legislation Mega projects and events Donations, aid (usually tied) Hierarchy, inequitability Specialization, experts Fantasies about deceptively simple futures Single, simple relationships Narrow, partial, short-term view (unaware) Missing and incorrect information Non-renewable resource consumption Capital intensive Inflexible, monotonous Afraid, defended, secretive, distrustful, dishonest Pseudopower, violent, competitive, lonely Negative environmental impact, unsustainable	Studies: monitoring, reasoning Multiple, complex relationships Mega research Commissions, hearings, reports Conferences, workshops Mega media, publication (paper, tape, film) Proliferation of special courses, degrees, societies, interest groups Escapes: compulsive, compensatory behaviours: addictions, cults, religions, consumption, stimulation Discontent, guilt Diminished responsibility Postponement of action More sophisticated, integrated external, curative solutions to internal problems: efficiency, substitution, more subtle control Repair, regeneration efforts	Internal, benign solutions to internal problems Recognition of benign, supportive, self-healing earth and self Interconnectedness, oneness Attention to integration, participation, balance, feedback Problems are indicators of malfunction, maldesign Responsible for self, group, species, biosphere Attention on the present Renewable resources, sustainably managed Flexible, spontaneous, unique Preventive, redesign, indirect, low-power, local solutions to causes of problems Powerful, independent, supportive, anonymous, cooperative, equitable Appropriate, decentralized technologies Local self-reliance Joyful, loving, open, honest, evolving

information, every potential solution generates a whole new host of problems, we continue to study rather than act, and we perceive multiple relationships but feel unable to explain them. In the profound simplicity stage, we perceive elegant, indirect solutions to problems, feel less need to control our environment, and are able to distinguish the relevant from the irrelevant. A profoundly simple strategy, for example, might be to "buy local". Although it seems obvious, its implications are profound, multifaceted, unique to each locale, more responsive to local needs, decentralized and cooperative. It is a strategy that indirectly addresses a number of agricultural problems. This conceptual tool has been used in the assessment of case similarities.

c) Supports, rewards, penalties categories. A further conceptual tool to assist in identifying case similarities involved dividing them into support, reward and penalty categories (Hill, 1982). Supports encourage a particular development. Rewards acknowledge and reinforce positive behaviours and actions. Penalties inflict damages for inappropriate behaviours or actions.

There also is a dynamic interaction between two cases because, while assessing the relevance of one case to another, one must also assess the relevance of the latter to the former. Diesing (1972:184) observed that, "Comparison provides a bridge between the variability and uniqueness of a case and the uniformity and generality of theory. The bridge is two-way: It makes theory available to guide and control observation, and it makes observation available to test and improve theory".

The explanatory scheme (or general theory) is developed to better understand individual cases, not to make predictions about unknown phenomena. The discovery of a general principle or framework may provide solutions to new problems more readily than finding a solution only suited to a specific problem (de Bono, 1967). The general theory applies to all types determined in the study and describes what they have in common, where variations exist and what the common variants are. Theory emerges through the examination of typologies, in a manner similar to the development of cases from themes. A general theory is holistic, concatenated[8] rather than hierarchical, close to ordinary experience (including the often emotive and subjective) rather than removed and objective, and is frequently related dialectically to other general theories (i.e., elaboration of one draws attention to the opposite which has been denied or excluded, or the opposite is required for the validity or applicability of the first). Examples of dialectical relationships include content and process; individual and institutional behaviours; unity and diversity; consensus and conflict.

At all these levels (case, type, typology) it is important to think in cycles. There is a constant process of data gathering, analysis and reflection, integrating and explaining, and evaluating to help again with data gathering (Fig. 9). At some point, however, the research cycle must come to a close and feedback on conclusions must be received (Reinharz, 1981; Lincoln and Guba, 1985).

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8. A series connected like links in a chain.

Figure 9
Cycles of investigation
(adapted from Reinharz, 1981)

<u>Acting and Experiencing</u>
Data-gathering, document analysis, interviews, workshops, participating in sustainable agriculture movement

<u>Reflecting</u>
Standing back from the data and the experience, formulating ideas, patterns, themes

<u>Evaluating</u>
Evaluating the entire process (person, content method)

<u>Communication and Planning</u>
Creating closure on what has been learned, asking new questions, receiving feedback on closure

<u>Integrating</u>
Combining reflections with ideas and theories developed elsewhere, sifting, recombining, testing, developing new ideas

3.3 Literature analysis, interviews, workshops and audit trail

3.3.1 Literature analysis

As in the Muir and Sudar (1987) study, the first element of observation is the scientific literature itself, drawn from many disciplines. There must, however, be a framework for assessing and organizing this literature. In the present study the overall assessment framework is provided by the organizational context of the literature being examined, the circumstances of data collection, the biases of the researchers, and the agroecological paradigm.

Within this overall framework, two kinds of literature were analysed:

* **Process literature** or literature that sets out the criteria and context for assessing other documents: this included disciplinary criticisms (Table 13), and literature on the criteria for choosing areas to investigate (see below). As a result of this review, certain kinds of documents were deemed unusable for further analysis. These included literature that:

a) contains a very reductionist analysis; has no connections to the agroecological paradigm; is based on assumptions unrelated to sustainable agriculture;

b) has too low a level of analysis below the field level (see above);

c) is very general or takes no account of institutional realities (with the exception of literature that is clearly visionary or normative);

d) has little relevance to Canadian conditions;

Table 13
List of disciplinary criticisms read

Economics

Georgescu-Röegen 1971
Schumacher 1973
Henderson 1978, 1981, 1987
Robertson 1983
Schrecker 1984
Breimyer 1984
Ekins 1986a*
Madden 1986a
Martinez-Allier 1987

Food and Agricultural Sciences

Hanway 1978
Hill 1980, 1982, 1985a, 1986b, 1987
Grierson 1980
Busch & Lacy 1982, 1983, 1986*
Haynes & Lanier 1982*
Hodges & Schofield 1983
Busch 1984
R. Jackson 1984
Lewins & Lewontin 1985
Altieri 1987
W. Jackson 1987

Political science

Jung 1972
Satin 1978
Friedmann 1981
Jackson & Atkinson 1981
Barber 1984
Dahlberg 1986c*
Anderson 1987

Science (general)

Kuhn 1970
Leiss 1972
Mahoney 1976
Bahm 1979
de Rosnay 1979
Skolimowski 1981
Capra 1982
De Mey 1982

Education / Extension

Romey 1976
de Rosnay 1979
Reason & Rowan 1981a*
Haynes & Lanier 1982*
Heffernan 1984
Bawden et al. 1984
Miles & Huberman 1984
Blackburn 1986
Lovejoy & Napier 1986
Duff et al. 1989
Gage 1989

Management

Peters & Waterman 1982
Plumptre 1988
Evans & Russell 1989
Wright & Morley 1989*

Psychology

Jackins 1965
Maslow 1966
Mahoney 1976
Reason & Rowan 1981a*
Miles & Huberman 1984
Reason & Heron 1986
Allender 1987

Sociology

Buttel & Newby 1980*
Heffernan 1984, 1986
Lovejoy & Napier 1986*

Science (general, cont.)

Miller 1982, 1983b, 1984, 1985a
Lincoln & Guba 1985
Bortolt 1986
Weber 1986
Harman 1988

* Many articles in this volume

e) expresses no knowledge of concepts of sustainabiity, or no concerns about the direction of agriculture[9].

The institutional areas to investigate were determined by reviewing surveys of farmers following sustainable practices, and from literature describing the impacts of institutional activities on agricultural development. The results of the literature review are presented in Table 14. As identified by these studies, the greatest disadvantages of, or obstacles to, sustainable practices are: a lack of technical information or appropriate diffusion methods, a lack of marketing information or excessive marketing structural obstacles, and the absence of relevant research performed by the conventional agricultural research establishment. In those studies that asked about it, agricultural policy was perceived as a significant problem.

The academic literature concerning the role of institutions in the creation of our present unsustainable system places more emphasis than do farmers on problems with government policy. The USA Congress Office of Technology Assessment (1986), in a survey of policy analysts, ranked commodity and taxation policy as the most important factors, followed in order by credit, monetary and fiscal, regulatory, trade, research and extension, and finally environmental policy. Taking a longer historical view, de Janvry and LeVeen (1986) identified how these same policies have supported the commodification of land, labour and capital, and how this

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9. It is valuable, however, to analyze "extreme cases" where the analysis is very much at variance with the preliminary themes or case models determined. But for the extreme case to be useful, criteria a) and e) must not apply, i.e., there must still be some recognition of concern for the future of agriculture and the document must contain some non-reductionist elements.

Table 14
A review of institutional barriers identified by farmers practicing and in transition to sustainable agriculture as identified in surveys

Problem / Study and location	Technical advice from conventional institutions	Marketing channels and information	Profitability of operation	Research by conventional institutions	Agricultural policy (safety nets, taxation)	Credit policy	Input supplies	Labour cost and availability
Wernick & Lockerertz, 1977 USA Corn Belt	3	3	1	0	0	1	0	1
Lockeretz & Madden, 1987 USA Corn Belt	3	3	1	0	0	1	0	2
Blobaum, 1983 USA Corn Belt	3	3	1	3	0	2	2	0
Baker & Smith, 1987 New York State	3	3	0	2	0	0	0	2
Teichert & Shulz, 1987 New England	2	3	0	2	2	2	0	0
Kramer, 1984 Canada	3	2	2	3	2	1	0	2
Robinson, 1985 Manitoba	3	0	1	0	2	0	0	3
Robinson, 1986 Ontario to BC	2	0	0	2	3	0	2	0

Key:
3 Major problem (in the top three problems identified by the producers); 2 Medium problem (identified as a significant problem by some producers)
1 Minor problem (idenfitied as a problem by a few producers); 0 Not a part of the study

commodification has undercut the principles of sustainability. They also identified how the integration of agriculture into the agribusiness chain created an industrial (nonecological) food system. The role of agribusiness policy in undermining sustainability has also been discussed by, among others, Mitchell (1975), Merrill (1976), Rodefield et al. (1978), Warnock (1978), Vogeler (1981), Wessel (1983), Troughton (1985), Heffernan (1986) and Kneen (1989a, 1990).

Based on this literature, and the conclusions drawn from the literature review (Section 2.0), three institutional areas emerged as significant on which to focus this study:

a) governmental and paragovernmental agencies (particularly subsidy, commodity and regulatory policy, crop insurance and stabilization, marketing structures and supports, and extension services);

b) research institutions (including both universities and governmental and para-governmental agencies, and the interaction between research and the diffusion/adoption process); and

c) agribusiness (especially its ability to control marketing mechanisms for farmers).

This selection addresses the main concerns expressed by farmers, and also recognizes the forces that the academic community has identified as critical to the evolution of unsustainable practices in the food and agriculture system.

* **Content literature:** the literature on institutional problems and strategies that were analyzed from a wide variety of popular and disciplinary perspectives. This included the literature of sustainable agriculture proponents (groups and individuals), and the institutions that they

attempt to affect[10]. The process of analyzing this literature is as follows:

a) The document was read: notes were taken on pertinent information; and the document summary form was prepared (see Appendix 2 for an example). Documents were selected based on recommendations of colleagues or food system players, or using the snowball sampling technique; i.e., using the reference list of one document to identify further documents. This is not a random, but rather a purposeful, sampling technique (Bogdan and Biklen, 1982).

b) The document summary forms were reviewed for themes (patterns).

c) The themes were recorded on theme summary forms; supporting observations and their sources were listed; contradicting information was sought and listed; and themes were revised with new information.

d) A preliminary attempt was made to assemble restraining cases using relationships between themes. These relationships were causal, functional, symptom and source, and means and ends, as identified earlier.

e) Information was assembled into three readable and reviewable documents (one for each institutional area) and distributed, two of them by mail. In the case of the document on research institution barriers, the length precluded reading by any significant number of reviewers. Instead, a poster session was prepared to provide the basic information on barriers and potential solutions. It was displayed at a conference on farmer-researcher cooperation in Fredericton, NB.

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10. Literature that provides specific data or introductory information in a subject area, and connecting or elaborative literature that connects or elaborates on specific points, will also be used but not analyzed in the same way.

f) A list of reviewers was assembled. For all three institutional areas the following distribution of reviewers was desirable:

* extreme cases (people with a clearly opposing view [including politically left and right]; here, explicit falsification was sought to avoid the trap of "consensus collusion" (Reason and Heron, 1986);

* people having different roles in the food system;

* internal and external critics of an institution;

* internal and external supporters of an institution;

* experts and popular proponents from different disciplines and backgrounds.

The breakdown of reviewers for each area is provided in Table 15. The form used to solicit comments is provided in Appendix 3. An assessment of each reviewer was also prepared to create a context for their comments (see Appendix 4 for an example).

In addition, five documents were reviewed by academic journals and comments from reviewers worked into the discussion. The topics of the reviewed papers were: the process of converting a farm to sustainable practices; agricultural credit problems for farmers following sustainable practices; barriers associated with research institutions; barriers associated with political institutions; and the evolution of sustainable agriculture education in Canada.

g) Once comments were received, contradicting and supporting comments and sources of evidence were transfered to appropriate restraining theme and case forms.

h) Driving cases were identified from restraining ones. Confirming and disconfirming information was identified and modifications made where indicated.

Table 15
Categorization of reviewers of documents and poster session

Institutional Area	Extreme case[a] left	Extreme case[a] right	Critics int.	Critics ext.	Supporters int.	Supporters ext.		Sector	Responded?
Government									
Totals	3	4	10	28	9	5	7	Farmers	2
							7	Federal govt.	5
							9	Provincial govt.	3
							2	Business	1
							8	Activist	6
							2	Para-govt.	2
							13	Academic	3
							3	Farm org.	1
							1	Consultant	1
							52		24
Research (poster session)									
Totals			4	4		1		Farmer	1
								Activist	2
								Academic	5
								Consultant	1
									9
Agribusiness									
Totals	2	3	3	25	3	6	3	Farmers	0
							1	Provincial govt.	0
							5	Business	1
							15	Activists	7
							11	Academics	3
							1	Farm org.	0
							1	Para-govt.	1
							37		12

[a] Extreme cases do not appear directly in totals as they are counted in other categories.

i) Once sufficient driving cases were assembled, it was possible to develop typologies using controlled comparison.

j) The development of an explanatory scheme (general theory) from typologies followed similarly to the process of developing cases from themes.

3.3.2 Interviews, workshops and questionnaire

Concurrent to the reflective literature analysis, interviews, workshops and an informal questionnaire were carried out with people directly involved in the food system (farmers, scientists, politicians, bureaucrats, business people).

For interviews: Two kinds of interviews were carried out:

a) Interviews to generate new information that could not be found in documents. This was necessary because sustainable agriculture is at an early stage of development in Canada and much has yet to be formally documented.

b) Interviews to discuss specific concepts and strategies as a more detailed part of the search for themes and cases. In particular, I was looking for confirming or disconfirming themes. Whenever possible, the interviewees were sent a summary of the interview to verify the accuracy of the interpretation of the interview. Interviews were open-ended and unstructured. An assessment of the context of the interview and the philosophical oriention of the interviewee was performed for each interview (Appendix 5).

Interviews were conducted with 27 individuals (10 producers, 3 merchants, 4 policy analysts [academic or civil service], 6 trainers and technical advisers, 4 public interest advocates). The key information from the interviews is presented in Section 4.1 as part of the development of general theory. Almost all of the interviews were conducted within the interviewee's working environment. Although this approach, in some cases, limits the scope of the discussion (cf. Miles and Huberman, 1984), it is consistent with an action research framework. The work context provides the interviewer with a clear idea of the interviewee's preoccupations in their working environment.

For workshops: Two kinds of workshops were undertaken: to identify driving and restraining forces; and to test ideas, to generate new ideas about strategies for overcoming institutional barriers, and to confirm or disconfirm information collected from other sources. Data were collected from eight workshops (Table 16). These data were recorded by the participants in the workshop or were transcribed from videotape, cassette or notes taken on a blackboard by the facilitator. Questions posed of participants are provided in Appendix 6.

In both types of workshops, I attempted to gather people together in a context familiar to them (at regular seminars, at conferences, in the work place) in order to be consistent with the action research framework.

A questionnaire: One simple, informal questionnaire was disseminated to 40 active proponents of sustainable agriculture systems in Europe and North America. Sixteen questionnaires were returned. The purpose was to obtain ideas on how these people perceived the importance of a range of potential policy initiatives to support sustainable agriculture. The questionnaire and results are provided in Section 4.1.

Table 16
Workshops conducted and used for data collection

Location and participants	Date	My role	Topic
Lennoxville, QC PEI Dept. Agriculture extension agents	9/87	Facilitator	Conversion to sustainable agriculture
Kemptville, ON Farmers, extension agents, policy makers (ON and federal)	4/88	Facilitator	Political barriers to sustainable agriculture
Winnipeg, MN Manitoba producers and consumers	6/88	Stuart Hill Facilitator	Linking producers to consumers for sustainability
Orangeville, ON Ontario public interest advocates	10/88	Facilitator	Strategies to change the food system
Ste-Hyacinthe, QC Farmers, extension agents, policy makers (QC and federal)	2/89	Participant	Research needs in sustainable agriculture
Minneapolis, MN Certification agency representatives and members of the organic foods industry	3/89	Participant	Development of reciprocity agreements between organic certification agencies
Williamstown, MA Producers, consumers institutional employees (government, universities)	7/89	Facilitator	Institutional barriers to adoption of sustainable agriculture
Ste-Anne de Bellevue, QC Staff and graduate students of the Soil Department, Macdonald College	9/89	Facilitator	Scientific barriers to multidisciplinary research

3.4 Validity and rigour

Holistic inquiries of this kind are prone to certain dangers such as, "interpreting events as more patterned and congruent then they really are" (Miles and Huberman, 1984:230), and unaware projection of cultural bias, character defense, political partisanship, and spiritual impoverishment on the part of the investigator (Reason and Heron, 1986). Consequently, rigour and validity are critical elements of a successful study. Reason and Rowan (1981b) reviewed, in detail, approaches for ensuring validity and rigour in science used in both established and new paradigm research (Table 17). They suggested that a diverse mix of approaches is desirable. Most established approaches focus on measurement and experimentation, but three others are reported in the literature: face validity (whether it looks right to the discriminating observer); convergent or discriminant validity, defined by Reason and Rowan (1981b:240) as "... [when] a number of measures which purport to measure the same thing all point in the same direction"[11]; and contextual validity (how any piece of data fits in with the whole picture). The latter two approaches are particularly important for the pattern model method.

Literature on new paradigm research identifies four other approaches to validity: catalytic (allowing individuals or groups to take action based on the study results); useful and illuminating (providing a clarity on a topic that was not previously apparent); if the results of

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11. Also referred to as triangulation, a term taken from surveying (Miles and Huberman, 1984).

Table 17

Validity in science

(Reason and Rowan, 1981b)

Traditional approaches

1) measurement (definition, statistics, control of variables)
2) experimentation
3) face validity
4) convergent or discriminant validity
5) Contextual validity

New approaches

6) catalytic (allows for action)
7) useful and illuminating
8) changes do bring about observed outcomes
9) rigorous tension between looking at assumptions and phenomena

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the research bring about the observed outcome (when action is taken it produces the effects discussed in the study); and, the existence of a rigourous tension between the investigator's examination of personal assumptions and the phenomena being investigated (i.e., a constant process of examining assumptions, biases, and fears in order to ensure that the observer is thinking clearly about the phenomenon being observed).

There are certain requirements that must be met for these new approaches to validity to be successful (Table 18). Three critical elements for this study (already partly discussed above) are: feedback loops, support and challenge from peers and food system participants for confirmation and falsification[12]; and systematic personal and interpersonal development. For the latter, investigators have suggested different techniques (e.g., Habermas [1971] suggested psychoanalysis; Reason and Heron [1986] suggested re-evaluation counseling). Because new paradigm researchers consider "objectivity" to be an unrealizeable and unnatural goal, it is essential that the investigator exercise self-examination to clarify such things as assumptions, biases, and obstacles to clear and rational thinking (see Appendix 1).

Miles and Huberman (1984) also identified the importance of regarding outliers and exceptional cases as integral parts of the analysis, rather than ignoring them or smoothing them over. They claim that rigourous qualitative analysis more thoroughly explains exceptions and rival explanations than most surveys and laboratory studies.

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12. Ideally support and challenge is rooted in rational behaviour, rather than the personal distresses described in Appendix 1. It is more usual, however, to receive both rational and irrational feedback.

Commentary on the success of ensuring validity is provided in Section 6.0.

Table 18

Requirements of new approaches to validity

(Reason and Rowan, 1981b)

1) high quality awareness on part of researcher (researcher awareness is primary instrument)

2) systematic method of personal and interpersonal development (know thyself)

3) working with others (support and challenge)

4) feedback loops (for refinement, clarity and falsification)

5) interaction between different forms of knowing (experiential, practical, presentational, and propositional)

6) using contradiction systematically

7) looking from different angles, different sources, different methods

8) replication in some form

4.0 Results

The results of the reflective literature analysis are presented in tables in Section 4.2 and discussed in great detail in Section 5. The data and some commentary on the interviews, workshops and questionnaire are provided below. These data are then incorporated into the tables in Section 4.2.

4.1 Interviews, workshops and questionnaire

4.1.1 Interviews

Government: Interviewee comments on government involvement in sustainable agriculture are presented in Table 19. Interviewees from all sectors of the food system identified a full range of negative effects of government programs and regulations on their activities. Several organic producers acknowledged that they did benefit from certain government programs, but they felt that their eligibility was not explicitly a function of their organic practices. The view was held by many interviewees that existing government policies, programs and regulations could be modified with relative ease to broaden eligibility for those following sustainable practices. They highlighted government activities in other jurisdictions that could be applied in Canada to support sustainable agriculture. Several interviewees confirmed preliminary conclusions regarding the importance of middle managers in the civil service as driving forces for change. Some interviewees had had successful

Table 19

Summaries of interviewee comments on governmental involvement in sustainable agriculture

Remark	Code	Role in Food System	Comment used where?
G1. No problems obtaining beef and cereal stabilization	I.Br88 I.Co88 I.Ze88	Organic farmer Farmer Organic farmer	RTG20.1
G2. Cannot get crop insurance because does not use chemicals	I.Br88	Organic farmer	RTG20
G3. No problem obtaining crop insurance	I.Br88	Organic farmer	RTG20.1
G4. Labelling regulations a major problem for producing and marketing alternative meat and processed products	I.Co88 I.Cl88	Farmer Manufacturer	RTG17
G5. Difficulty obtaining credit because do not use chemicals and financial accounts are disputed	I.Br88	Organic farmer	RTG18
G6. QC credit office and crop insurance becoming more open to supporting organic farming	I.La89	Trainer	DCG17
G7. Lack of full information on production systems for consumers is a problem	I.Co88	Farmer	RTG29
G8. Wheat Boards cause many problems for trading organic cereals	I.Sc88 I.Fi88	Organic farmer SA advocate	RTG16
G9. Dealing with CWB not a problem if the staff knows your situation	I.Mo88	Organic farmer and broker	RTG16
G10. Grading systems for meat encourage intensive grain feeding to achieve top grade	I.Sc88	Organic farmer	RTG21
G11. Biggest problem for setting up organic dairy is receiving permission from the Ontario Milk Marketing Board	I.Ze88	Organic farmer	RTG16
G12. Ontario's Land Stewardship Program can be used by organic farmers, but not for things that have already been started by the farmer	I.Ze88 I.An88	Organic farmer Organic farmer	RTG30
G13. It would be easier to convert with government support	I.Ze88	Organic farmer	DCG17,18
G14. S.A. has hidden supporters in OMAF who are afraid to publicly express their support	I.An88	Organic farmer	RTG13.1

Table 19 (cont.)

G15. Government shouldn't penalize without providing alternatives	I.An88	Organic farmer	DCG13,14,15,16
G16. Organic farming groups and businesses are receiving some financial support from governments	I.An88 I.Kl88	Organic farmer Organic farmer	RTG31
G17. Quebec government wants farmers to group together but won't provide sufficient financing for technical staff to support them	I.Ca88	Organic farmer	RTG31.1
G18. Government discrimination due more to small size and diversity than being organic	I.Kl88	Organic farmer	RTG18.1
G19. Sanitation regulations can be a problem for organic farmers and businesses	I.Sc88 I.Ki89 I.Cl88	Organic farmer Retailer Manufacturer	RTG19
G20. Not all states are enforcing their organic regulations	I.Sw89	Manufacturer	RTG34.1
G21. AB animal vaccine requirements contravene ideal organic certification standards	I.Re88	SA advocate	RTG19
G22. Organic bills should be written as labelling bills rather than agricultural bills because most difficulties are related to labels/regulations	I.Sw89	Manufacturer	RTG17
G23. Labelling requirements for importing US organic products are a problem because Canadian market too small to warrant separate labelling	I.Ki89	Retailer	RTG17
G24. US government price and income support policies penalize growers wishing to move to low-input rotations	I.Ma89	Government and university employee	RTG24
G25. US Congress is leading USDA in making positive changes. Farmer testimony has strong effect on Congress	I.Ma89	Government and university employee	RTG13
G26. Originally interest in LISA was in the middle of the USDA, not the top. Now interest at the top.	I.Ma89	Government and university employee	RTG6.1
G27. Fowler Bill strategy too direct, I prefer indirect approaches	I.Ma89	Government and university employee	Change analytical framework

Table 19 (cont.)

G29. Subsidies to organic crop production are not the best approach	I.[illegible]a89	Trainer	DCG18
G30. We cannot rely on Proposition 65-type legislation. Do preventative things to make regulatory approach less necessary and more effective	I.Ma89	Government and university employee	Change analytical framework
G31. Alberta government is not supportive of organic	I.Fi88	SA advocate	RTG13
G32. BC government developing labelling bill, although it is not particularly supportive of organic	I.Sa89	BC government employee	RTG13
G33. PFRA supports producer-initiated coops to deal with specific production problems	I.Kk89	Government employee	DCG21
G34. PFRA runs community pasture programs designed to assist small producers	I.Kk89	Government employee	DCG21
G35. PEI Dept. Agriculture minister and senior staff have been supportive of SA [since reduced with cabinet changes]	I.Cd88	Government employees	RTG6.1
G36. Conventional agriculture sector has pressured the department to not support SA	I.Cd88	Government employees	RTG5.1
G37. Dept. has created a SA section that runs a pilot project SA assistance program	I.Cd88	Government employees	DCG20
G38. Some middle management supportive of SA others not. Pressure for change did start in middle management	I.Cd88	Government employees	RTG5.1
G39. Organic is not supported in PEI dept. of agriculture	I.Cd88	Government employees	RTG13
G40. Extension staff too attached to conventional ideas of scientific evidence to give advice on organic	I.Cd88	Government employees	RCG35
G41. Need for retraining of farmers and extension staff	I.La89	Trainer	DCG19
G42. Success of SA in QC partly due to 15-17 years of government-funded farmer training programs	I.La89	Trainer	DCG19

Table 19 (cont.)

G43. Club de production model is an important one to use	I.La89	Trainer	DCG19
G44. QC network of regional extension agents responsible for organic is a good idea	I.La89	Trainer	DCG18
G44. MAPAQ support for machinery coops or loan agencies would facilitate transition	I.La89	Trainer	DCG20,21
G45. QC support for demonstration projects can be very successful	I.La89	Trainer	DCG19
G46. Insufficient on-farm research being supported by dept.	I.Cd88	Government employees	RTG35
G47. No willingness to examine how existing programs present barriers to transition	I.Cd88	Government employees	RTG13
G48. Government does not know how to evaluate credit worthiness of an organic farmer	I.Sl87	Farmer, government consultant	RTG18
G49. Federal Fertilizer Act is flexible, but designed for fraud control not promotion of specific agronomic practices	I.Wi88	Goverment employee	RTG28
G50. Manitoba government to support certification of organic products with legislation	I.Ho89	Government employee	DCG18
G51. Mass. has a transfer tax to fund land conservation	I.Sn89	Activitist	DCG21

communications with civil servants and felt that a more supportive environment was evolving.

Research: Comments on research institution involvement in sustainable agriculture are presented in Table 20. Interviewees complained about the lack of research to support sustainable agriculture, and the amount of money invested in researching conventional agricultural practices. Several expressed serious concerns that the research agenda is controlled by corporate interests. A few interviewees identified structural factors (reward systems, peer review, funding agencies) that they felt constrained interest in sustainable agriculture on the part of scientists and economists. A lack of appropriate scientific training was also identified as a factor.

Agribusiness: Comments on agribusiness involvement in sustainable agriculture are presented in Table 21. Many of the comments focused on the difficulties of creating a coherent marketplace for organic products. Only one interviewee had any specific comments on the problems imposed by large agribusiness firms on the development of sustainable agriculture. This appears to be an area in which many have difficulty conceiving solutions.

4.1.2 Workshops

Government: Summaries of workshop comments on government involvement in sustainable agriculture are provided in Table 22. Workshop participants identified problems with government programs and regulations similar to those presented by interviewees. A number of workshops were designed to look at solutions. Most of the proposals for change that

Table 20

Summaries of interviewee comments on research institution involvement in sustainable agriculture

Remark	Code	Role in Food System	Comment used where?
S1. No SA courses at U. Manitoba	I.Ho89	Government employee	RTS34
S2. Some talk about research on organic at U. Manitoba	I.Ho89	Government employee	RTS1
S3. Agriculture Canada is interested but await direction	I.Ho89	Government employee	RTS1
S4. Too much research goes into infrastructure instead of soil research	I.Ca88	Organic farmer	RTS1
S5. Need research on "organic" sprays that don't clog spray nozzles	I.Kl88	Organic farmer	DCS4
S6. Need spray and variety trials	I.Kl88	Organic farmer	DCS4
S7. AI research and practice only accounts for yield, not health factors	I.An88	Organic farmer	RTS1
S8. Need research on manure management	I.An88	Organic farmer	DCS4
S9. Field scale studies are needed	I.An88	Organic farmer	DCS4
S10. Farmers and scientists have little mutual respect, so on-farm research is needed to overcome this	I.An88	Organic farmer	DCS7
S11. Need research on windbreaks, straw use in manure, weed balance, composting technology	I.La89	Trainer	DCS4
S12. Legislators put pressure on U. Minnesota to incorporate SA into their research program	I.Gi88	SA activist	DCS29
S13. Changing attitudes of a few key scientists put pressure on the U. Minnesota	I.Gi88	SA activist	DCS11
S14. Pressure by public interest groups also changed U. Minn. attitudes	I.Gi88	SA activist	DCS29.1
S15. Scientists interested in SA now drawn to U. Minn. because they feel the environment there is safe	I.Gi88	SA activist	DCS14

Table 20 (cont.)

S16. Scientists are realizing they must do innovative things to obtain LISA funding	I.Gi88	SA activist	DCS25
S17. Initiatives by neighbour states also put pressure on U. Minn.	I.Gi88	SA activist	DCS29
S18. Hiring new people committed to SA is very effective, especially with a conventional background	I.Gi88	SA activist	DCS5
S19. State providing funding generated structural changes at U. Minn.	I.Gi88	SA activist	DCS27
S20. Student pressure was also a factor in changing U. Minn. attitude to SA	I.Gi88	SA activist	DCS29.1
S21. Some interest in SA in U. Alberta soil department	I.Fi88	SA activist	RTS1
S22. Resistance to SA in U. Alberta Agricultural Economics department	I.Fi88	SA activist	RTS1
S23. Traditional training of extension agents received at universities is not appropriate for SA	I.Cd88	Government employees	RTS34
S24. Insufficient on-farm research being undertaken in PEI	I.Cd88	Government employees	RTS1
S25. Continuity of funding the best way to encourage SA research in universities and on-going commitment by researchers	I.Ma89	Government and university employee	DCS27
S26. Reward system must explicitly reward SA research (even more powerful than money)	I.Ma89	Government and university employee	DCS14
S27. Difficult to change reward system because it involves some sacred cows, deeply rooted vested interests, and disciplinary standards of excellence	I.Ma89	Government and university employee	RTS21,25,26
S28. SA journals are having some positive effect, but won't be widespread unless conventional people legitimate the journal	I.Ma89	Government and university employee	DCS18
S29. Need to broaden the peer review process	I.Ma89	Government and university employee	DCS19
S30. Senior faculty have tremendous influence on behaviour of juniors	I.Ma89	Government and university employee	RTS21

Table 20 (cont.)

S31. Not optomistic that values can be integrated into agricultural curricula	I.Ma89	Government and university employee	RTS15
S32. Many agricultural professors believe that values should only be discussed in philosophy department	I.Ma89	Government and university employee	RTS18

Table 21

Summaries of interviewee comments on agribusiness involvement in sustainable agriculture

Remark	Code	Role in Food System	Comment used where?
A1. Farmers have to clean own export containers	I.Br88	Organic farmer	DCA7.1
A2. No well-developed market for young organic beef	I.Br88	Organic farmer	DCA7.1
A3. Finding efficient local suppliers a problem	I.Ki89	Retailer	DCA7.1
A4. Finding growers who do appropriate grading, sizing and washing a problem	I.Ki89	Retailer	DCA7.1
A5. Uncoordinated pricing systems between stores and farm gate	I.Ki89	Retailer	DCA7.1
A6. Large chains won't buy without large volume	I.Co88	Organic farmer	DCA7.1
A7. Custom slaughtering used because we lose money in public slaughter houses	I.Sc88	Organic farmer	DCA7.1
A8. We export grain to Europe because Canadian market not well developed	I.Sc88	Organic farmer	DCA7.1
A9. Dairy processors are interested in organic	I.Ze88	Organic farmer	DCA7
A10. Too much competitive, rather than cooperative, attitudes in organic food industry	I.Sw89	Manufacturer	DCA7.1
A11. Lack of organic supply is the biggest business obstacle	I.Sw89	Manufacturer	DCA7.1
A12. Companies that don't have to report publicly on their activities are the most difficult to counter	I.Gi88	Activist	RTA15
A13. Key strategy is to match their intelligence network, such as PAN	I.Gi88	Activist	DCA14
A14. Another strategy is to lobby for international codes	I.Gi88	Activist	DCA16
A15. Under pressure from citizens' groups, governments are banning hazardous agri-chemicals or regulating them, resulting in lower profits by forcing the internalizing of costs	I.Gi88	Activist	DCA9

Table 21 (cont.)

A16. Citizen groups are trying to support firms producing more environmentally benign products	I.Gi88	Activist	DCA15
A17. Hard to achieve a "comprehensive" economics using government regulations	I.Gi88	Activist	Analytical framework
A18. Cargill is smart - they work in oligopolies, not monopolies in order to avoid regulators	I.Gi88	Activist	RTA1
A19. Cargill is brilliant at playing by the rules and in some ways they are very efficient	I.Gi88	Activist	Analytical framework
A20. Disclosure laws could be changed, but would affect everyone, not just a targeted group	I.Gi88	Activist	DCA18
A21. Problem with Cargill is their power, concentration and lack of external control	I.Gi88	Activist	RTA1
A22. You can't argue against capitalist efficiency to legislators, they don't see agribusiness activity as a cause of rural decline	I.Gi88	Activist	Analytical framework
A23. USA won't develop marketing boards to address the equity question	I.Gi88	Activist	Not pertinent to Canadian context

Table 22
Summaries of workshop conclusions concerning government involvement in sustainable agriculture

Conclusions	Workshop and code	Used where?
G1. Problems with the ON wheat board because no organic food distribution channel	Kemptville (W.Ke88)	RTG16
G2. QC and ON Milk Marketing Boards do not permit processing and distribution of organic milk [since changed as of 8/89 in QC]	Kemptville (W.Ke88)	RTG16
G3. Goat milk controlled by same board as cow milk in ON so no distribution of organic goat milk	Kemptville (W.Ke88)	RTG16
G4. ON Soybean Marketing Board does not prevent distribution of organic soybeans, but distribution must be set up by the farmer	Kemptville (W.Ke88)	RTG16
G5. Dairy sanitation requirements a barrier in ON	Kemptville (W.Ke88)	RTG19
G6. ON egg grading based on size, not quality characteristics	Kemptville (W.Ke88)	RTG21
G7. Can only sell organic eggs locally if farmer has below quota limitation of number of birds [exception now in ON as of 7/89]	Kemptville (W.Ke88) Ste-Hyacinthe (W.Sh88)	RTG16
G8. Fair marketing boards must must be developed	Winnipeg (W.Wg88)	RTG16
G9. Difficulties obtaining crop insurance in QC and ON if not using chemicals	Kemptville (W.Ke88)	RTG20
G10. Difficulties obtaining credit for some organic farmers in some regions	Kemptville (W.Ke88) Lennoxville (W.Le88)	RTG18
G11. Government suffers from info-glut or poorly targets its information	Williamstown (W.Wi89)	RTG10
G12. Values of corporate and government employees similar, partly because they move back and forth between public and private sector employment	Williamstown (W.Wi89)	DCG9
G13. Existing successful government programs need to be duplicated and disseminated	Williamstown (W.Wi89)	DCG15,16,17, 18,19,20,21
G14. Training and education programs are critical	Williamstown (W.Wi89) Orangeville (W.Or88)	DCG19

Table 22 (cont.)

G15. Have to identify allies in government and support them	Williamstown (W.Wi89)	DCG6
G16. Advocates need better lobbying strategies	Williamstown (W.Wi89)	DCG6,7,8
G17. Government subsidizes the chemical industry	Winnipeg (W.Wg88) Orangeville (W.Or88)	RTG11
G18. Government develops laws to regulate the percentage of locally-grown food required	Winnipeg (W.Wg88)	DCG16
G19. Return to constitutional government	Winnipeg (W.Wg88)	DCG25
G20. Government labelling requirements for beef are a barrier	Ste-Hyacinthe (W.Sh88)	RTG17
G21. Government procurement practices should support SA	Orangeville (W.Or88)	DCG21
G22. Eliminate subsidies to non-sustainable practices	Orangeville (W.Or88)	DCG14
G23. Subsidize SA practices, especially transition	Orangeville (W.Or88)	DCG18
G24. Develop food standards based on environmental criteria	Orangeville (W.Or88)	DCG10
G25. Government should provide legal support to certification	Orangeville (W.Or88)	DCG18
G26. Get rid of Canada Food Guide	Orangeville (W.Or88)	RTG29
G27. Provide disincentives to non-sustainable activities	Orangeville (W.Or88)	DCG14
G28. Government has no useful role to play in promoting SA	Orangeville (W.Or88)	RTG13
G29. Need strict pesticide regulations	Orangeville (W.Or88)	DCG15
G30. Avoid centralized, institutionalized decision making	Orangeville (W.Or88)	RTG7
G31. Internal reform is not a viable solution	Orangeville (W.Or88)	RTG13
G32. PBR legislation runs counter to SA	Orangeville (W.Or88)	RCG6

emerged were general in nature. It appears that many individuals and groups have yet to develop detailed proposals on how to make the food system more sustainable.

Research: Summaries of workshop comments on research institution involvement in sustainable agriculture are provided in Table 23. Workshop participants did identify several promising developments that they felt should be implemented in other organizations and institutions. The overall impression was that more progress has been made in research institutions than within governments, although considerably more work must be done.

Agribusiness: Summaries of workshop comments on agribusiness involvement in sustainable agriculture are provided in Table 24. Workshop participants also identified problems with an incoherent market for organic products. Proposals for making agribusiness firms allies in the creation of a sustainable system were of a general nature, likely reflecting the extent to which many see only intractable problems. In comparison to government and research institutions, this area appears to have received the least attention by proponents of sustainable agriculture.

4.1.3 Questionnaire

A summary of the information is provided in Table 25. Respondents were particularly favourable toward national organic certification standards and programs, regulatory support for organic certification, labelling requirements on production practices for all foodstuffs, on-farm demonstration plot programs, creation of sustainable agriculture research farms, training programs for farmers, retraining for scientists and

Table 23
Summaries of workshop conclusions concerning research institution involvement in sustainable agriculture

Conclusions	Workshop and code	Used where?
S1. Conventional research efforts are not promising for addressing SA problems	Orangeville (W.Or88)	RTS1
S2. Chemical industry funded research is a major obstacle	Orangeville (W.Or88)	RTS25
S3. Erosion is due to economic pressure, not the side effects of agricultural research and technology	Lennoxville (W.Le88)	Not used, superficial analysis
S4. A global scientific approach is not unique to SA	Lennoxville (W.Le88)	DCS33
S5. The most useful scientific work to extension agents is basic and specific	Lennoxville (W.Le88)	DCS33
S6. Extension agents are not pushing scientists to do on-farm research, but that would be ideal	Lennoxville (W.Le88)	DCS7
S7. Research institutions suffer from info-glut or poorly target their information	Williamstown (W.Wi89)	RTS4
S8. Existing successful examples of SA research projects and models need to be duplicated and disseminated	Williamstown (W.Wi89)	DCS1,2,3,4, 6,7,12,13, 27,29
S9. Training and education programs are essential	Williamstown (W.Wi89)	DCS1,2,3, 10,11
S10. Advocates have to identify allies in research institutions and support them	Williamstown (W.Wi89)	All DCS
S11. Advocates need better lobbying strategies	Williamstown (W.Wi89)	All DCS
S12. A comprehensive agenda of SA research for Quebec has been developed	Ste-Hyacinthe (W.Sh88)	DCS4
S13. Many federal/provincial research funding agreements last only 5 years which is insufficient for long-term work	Ste-Hyacinthe (W.Sh88)	RTS29
S14. Universities must offer SA education programs so that government can hire appropriate people	Ste-Hyacinthe (W.Sh88)	DCS1,2,3, 10,11

Table 23 (cont.)

S15. On-farm research is a great priority	Ste-Hyacinthe (W.Sh88)	DCS7
S16. Farmers could do much of the research, with scientists providing coaching	Ste-Hyacinthe (W.Sh88)	DCS7
S17. Need multidisciplinary research, with global ecological approaches	Ste-Hyacinthe (W.Sh88)	DCS6
S18. We need to investigate how to modify practices and products that have been successful elsewhere	Ste-Hyacinthe (W.Sh88)	DCS4
S19. Need a complete program covering from basic research to demonstration	Ste-Hyacinthe (W.Sh88)	DCS1.1
S20. Farmers have much of the wisdom about SA in Quebec so interested scientists should consult with them	Ste-Hyacinthe (W.Sh88)	DCS7
S21. Farmers must be a part of the research priority setting process	Ste-Hyacinthe (W.Sh88)	DCS7,29
S22. Farmers could help finance some research to assure their participation in decisions	Ste-Hyacinthe (W.Sh88)	DCS23
S23. Farmers should receive some compensation for their work on on-farm research trials	Ste-Hyacinthe (W.Sh88)	DCS7
S24. Need cooperative research developed in each region	Ste-Anne de Bellevue (W.Sb89)	DCS1,7
S25. Need diverse reward systems to match diversity of scientists	Ste-Anne de Bellevue (W.Sb89)	DCS15
S26. Need a broader range of peers doing peer review	Ste-Anne de Bellevue (W.Sb89)	DCS19,28
S27. Need to close the distance between research and extension	Ste-Anne de Bellevue (W.Sb89)	DCS1.1
S28. Funding programs should match scientist objectives not other way round	Ste-Anne de Bellevue (W.Sb89)	DCS25
S29. Scientists working heavily on interdisciplinary research have lost their jobs, because team work not valued	Ste-Anne de Bellevue (W.Sb89)	RTS22
S30. Current reward system acts as a stress	Ste-Anne de Bellevue (W.Sb89)	RTS31
S31. Agricultural research should be in specialised institutes with university professors cooperating	Ste-Anne de Bellevue (W.Sb89)	DCS12

Table 23 (cont.)

S32. Industries should be taxed to fund agricultural research as happens in forestry in Quebec	Ste-Anne de Bellevue (W.Sb89)	DCS21
S33. Scientists need to interact more with the general public to "sell" their work	Ste-Anne de Bellevue (W.Sb89)	DCS29
S34. Reward system needs to reward creativity	Ste-Anne de Bellevue (W.Sb89)	DCS14,15
S35. Reward system needs to evaluate the impact of one's work	Ste-Anne de Bellevue (W.Sb89)	DCS15
S36. McGill focus on research penalizes undergraduates, benefits graduate students	Ste-Anne de Bellevue (W.Sb89)	RTS15
S37. Should be 3-year automatic funding because it takes 3 years to obtain some results	Ste-Anne de Bellevue (W.Sb89)	DCS24
S38. Funding agency fiscal year restrictions mean spending money on necessary things	Ste-Anne de Bellevue (W.Sb89)	RTS29
S39. Designate selected specific sites for long-term studies and fund them properly	Ste-Anne de Bellevue (W.Sb89)	DCS24
S40. Present peer review system works if there is a good journal editor	Ste-Anne de Bellevue (W.Sb89)	RTS30.1
S41. Reviewers biases can be a problem for publication and funding	Ste-Anne de Bellevue (W.Sb89)	RTS30
S42. Difficult for a peer to evaluate a new field	Ste-Anne de Bellevue (W.Sb89)	RTS30
S43. Peer review could be broadened by bringing in interested non-scientists but need to limit their feedback to their competency	Ste-Anne de Bellevue (W.Sb89)	DCS28

Table 24
Summaries of workshop conclusions concerning agribusiness involvement in sustainable agriculture

Conclusions	Workshop and code	Used where?
A1. Food should be decommodified	Orangeville (W.Or88)	Analytical framework
A2. Lobbying of large supermarkets is needed	Orangeville (W.Or88)	DCA5
A3. Consumers need action strategies	Orangeville (W.Or88)	DCA5,6,15
A4. Link agribusiness activity to poor food quality and high prices	Orangeville (W.Or88)	RTA6
A5. Dissemination of urban values is a factor limiting change in rural areas	Lennoxville (W.Le88)	RTA4,8
A6. Corporate power in marketing and advertising is a barrier	Williamstown (W.Wi89)	RTA14
A7. "Revolving door" between professionals and agribusiness is an obstacle	Williamstown (W.Wi89)	RTA5
A8. Need to support alternative services consistent with SA	Williamstown (W.Wi89)	DCA15
A9. Have to identify allies in agribusiness and support them	Williamstown (W.Wi89)	All DCAs
A10. Advocates need better lobbying strategies	Williamstown (W.Wi89)	Analytic framework
A11. Middlemen/monopolies in control of system	Winnipeg (W.Wg88)	RTA2
A12. Rural communities are in decline	Winnipeg (W.Wg88)	RTA9
A13. Food quality is declining	Winnipeg (W.Wg88)	RTA6
A14. Food distribution is too global in orientation	Winnipeg (W.Wg88)	RTA8
A15. Consumers need to buy locally	Winnipeg (W.Wg88)	DCA5
A16. Consumers need to ignore agribusiness advertising	Winnipeg (W.Wg88)	RTA14
A17. Consumers must demand organic food	Winnipeg (W.Wg88)	DCA5
A18. Consumers must demand full information on products	Winnipeg (W.Wg88)	RTA14
A19. Consumers should boycott undesirable products	Winnipeg (W.Wg88)	DCA6
A20. Consumers should encourage cooperative farm activity and fair marketing boards	Winnipeg (W.Wg88)	DCA3
A21. Farmers and consumers should work to eliminate corporate ownership in food system	Winnipeg (W.Wg88)	DCA1,2,3

Table 24 (cont.)

A22. Slaughter houses don't want to handle small quantities	Ste-Hyacinthe (W.Sh88)	DCA7.1
A23. Organic beef market does not have a well developed infrastructure	Ste-Hyacinthe (W.Sh88)	DCA7.1

Table 25

Results of an informal, simple survey of selected sustainable agriculture proponents in Europe and North America on the subject of strategies to facilitate the transition to sustainable agriculture

Strategy	Response	
	Positive	Negative
<u>Marketing</u>		
National organic certification standards and programs	9	0
Regulatory support for certified organic	8	0
Labelling requirements on production practices for all foodstuffs (could include resource, environment, nutritional information)	6	0
Buy local campaign	2	2
Financial assistance to farmers' markets	2	2
Buy organic campaign	2	1
Support for trade shows	1	1
Directories of market opportunities (u-pick, farmers' markets, etc.)	0	1
Export financing assistance	0	3
*Technical marketing assistance (business info, etc.)	1	0
*Direct marketing for organic or lean meat	1	0
<u>Research and demonstaration</u>		
On-farm demonstration plot programs	14	0
Creation of sustainable agriculture.research farms	10	1
Establishment of a special category of operating grants administered by Agriculture Canada (not requiring matching funds from industry, long-term teams, on-farm emphasis)	5	1
Changing evaluative systems for scientists to remove focus from publication record	3	0
*Farmer/researcher links	1	0
*Support for farmer advisors visiting farms	1	0
<u>Training</u>		
Training programs for farmers	13	0
Retraining programs for research and extension staff	10	0
Support for regional resource centres	4	0
Support for establishment of degree/diploma programs	3	0
*A Master Farmer program	1	0
<u>Penalties</u>		
Pollution taxes or agricultural chemicals	9	1
Ban certain production practices	6	1
Ban certain chemicals	5	1
Cross-compliance	4	2

Table 25 (cont.)

<u>**Financial assistance**</u>		
Subsidies for conversion	7	2
Tax relief for conservation practices	7	0
Low-interest loans	5	2
Subsidies for establishment of optimal waste management systems (composting, linkage with urban food processing plant waste disposal projects, etc.)	4	0
Crop insurance for the conversion period	4	2
Organic production eligible for set-aside schemes	2	0
*Open all existing financial programs to organic farmers	1	0
*Support prices for the deintensification period	1	0
*On-going support for organic/environmentally sound production	1	0

Notes

16 of 40 people responded to questionnaire.

Several different ranking schemes were used by respondents, so the top two strategies from each category were taken (including ties). In some cases, respondents did not check two strategies per category.

Positive response indicates that the respondent felt that it was a priority strategy within that category.

Negative response indicates that the respondent felt that the strategy was not appropriate.

* Strategy written in by respondents.

extension agents, pollution taxes on agrichemicals, and subsidies for the conversion period. These data are considered further in Section 4.4 as part of the development of a general theory, and in Section 5.

4.2 The development of an explanatory scheme (general theory)

4.2.1 Themes (patterns) and cases

Many preliminary themes and cases have been developed in the course of this study. Not all of them will be reported here as several were quickly rejected or proved not to lead anywhere. Others were not particularly important to the development of a general theory, so are not presented in this chapter but are part of the discussion. My objective is to provide sufficient numbers of themes and cases so that the reader can understand how the general theory was developed. These data are discussed at length in Section 5.

4.2.1.1 Governmental and paragovernmental institutions

Examples of some preliminary themes are presented in Table 26 (and Appendix 7). Some themes evolved before any serious reading of the literature, or interviewing of people involved in policy making, had taken place. As is shown in Table 27, many of these preliminary themes were modified as supporting and contradicting evidence was incorporated into the analysis (see a full listing in Appendix 8). I then began to assemble themes into cases (Table 28), to describe the nature of the relationships between themes that produced the case, and to test my preliminary

Table 26

Examples of preliminary themes: governmental restraining forces (barriers)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence
1. Absence of clear government goals	RTG1 2/88	Anecdotal	Jackson & Atkinson, 1980 RevFIG3
2. Absence of participatory goal setting process	RTG2 2/88	OPIRG, 1984	Barber, 1984 Friedmann, 1981 RevFIG4
3. Analytical tools have become goals	RTG3 2/88	Brooks, 1986 Madden, 1986a	Center for Philosophy and Public Policy, 1985; Brown, 1987; RevFIG5,7,10,18
4. Agricultural goals and policies evolved from crisis, compromise and non-agricultural objectives	RTG4 2/88	Warnock, 1984 Skogstad, 1987 Phidd, 1979	Perreault, 1987 Forbes, 1985 Veeman & Veeman, 1976 RevFIG6,19
5. Farm organizations have a profound influence on agricultural policy	RTG5 3/88	Forbes, 1985 Skogstad, 1987	

Code: R=Restraining; T=Theme, G=Government; Rev=Reviewer; FI=confirming comment. See Appendix 7 for a full listing of themes

Table 27
Examples of modifications to preliminary themes: governmental restraining forces (barriers)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and Date	Used for which case?
1. Absence of clear government goals (RTG1)	Clear implicit goals of productivity and efficiency as defined neoclassically	Agriculture Canada, 1981; SCC, 1979; Kneen, 1983 Georgescu-Roegen, 1971 RevTrG61	Contradictory explicit goals but clear implicit ones	RTG1.1 4/88	RCG1
2. Absence of participatory goal setting process (RTG2)					RCG1
3. Analytical tools have become goals (RTG3)	Ag. Can. uses tools to choose between apparently irreconciliable options	Ag. Can. 1981;1986;1987b;1989a Weinberg, 1972; Hammond et al., 1983; RevTrG74	Information collected lacks appropriate paradigm	RTG3.1 4/88	RCG2
4. Agricultural goals and policies evolved from crisis, compromise and non-agricultural objectives (RTG4)					RCG1
5. Farm organizations have profound influence on agricultural policy (RTG5)	1. Not all groups have access 2. Well-established groups get more favourable response 3. Only on insignificant issues 4. Commodity groups becoming more influential 5. Groups with few resources may have good relations with junior and middle management	1. Chandler & Chandler, 1979; Peoples Food Commission, 1980 2. Campbell & Szablowski, 1979; Dryzek, 1987 3. Miller, 1985b 4. Coffin, 1988 I.Cd88.G36 5. Pross, 1986, Chandler & Chandler, 1979 I.Cd88.G38	Well-organized groups providing information to government have access. Different groups have access at different levels.	RTG5.1 9/88	RCG3

Code: R=Restraining; T=Theme, G=Government; C=Case; Rev=Reviewer; Tr=contradicting; I=Interview; W=workshop

See Appendix 8 for a full listing of modifications

Table 28
Governmental restraining force cases created from restraining force themes

Cases	1. Absence of clear, rational long-term planning	2. Inadequate information gathering and evaluative tools	3. SA groups only have influence at certain levels	4. Governments do not explicitly support SA as policy
Code and date	RCG1 4/88	RCG2 4/88	RCG3 4/88	RCG4 4/88
Supporting themes and comments	RTG1.1; RTG2; RTG4; RTG5.1; RTG9.1; RTG12	RTG3.1	RTG5.1; RTG6.1	RTG7; RTG11; RTG13
Nature of relationship	Functional	Functional	Symptom and source	Functional
Results of testing	Root cause not identified	o.k.	o.k.	o.k.
Contradicting information	RevTrG35,41,55,56,64			
Revised case	Inadequate government management procedures			
New code and date	RCG1.1 6/89			

Codes: R=Restraining; C=Case; G=Governemnt; Rev=Reviewer; Tr=Contradicting comments

Table 28 (cont.)

Cases	5. Decision-making process is very diffused which constrains sound decision-making	6. Many government programs and policies restrict diversification	7. Many government programs and regulations make organic production and distribution more difficult	8. Many existing policies and programs have room for specific SA components
Code and date	RCG5 8/88	RCG6 8/88	RCG7 8/88	RCG8 8/88
Supporting themes and comments	RTG8; RTG10.1; RTG14; RTG15	RTG21; RTG22; RTG23.1; RTG24; RTG25; RTG26; RTG27; RTG28.1; RevFIG26	RTG16.1; RTG17; RTG18.1; RTG19; RTG20.1; RevFIG26	RTG29; RTG30, RTG31.1; RTG32; RTG33; RGT34.1; RTG35
Nature of relationship	Cause and effect	Symptom and source	Symptom and source	Functional
Results of testing	Absence of SA relevance	o.k.	o.k.	o.k.
Contradicting information	RevTrG54			
Revised case	Government can not effectively lead SA changes due to diffused decision-making process			
New code and date	RCG5.1 2/89			

Codes: R=Restraining; C=Case; G=Government; Rev=Reviewer; Tr=Contradicting comment; FI=Confirming comment conclusions. Summary remarks from interviews (Table 19) and workshops (Table 22) are incorporated into Tables 26, 27 and 28.

At this point, I assembled the information into a document and distributed it. The responses of the reviewers are summarized in Tables 29 (comments that contradict) and 30 (comments that confirm). I also assessed the strength of the comment based on my knowledge of the reviewer and the number and diversity of reviewers who provided any particular comment. It was clear to me from the comments that my analysis lacked an appropriate analytical framework. Forty two percent of the contradicting comments (Table 29) contributed to changing my thinking about such a framework. Other comments were more specific to particular themes and cases. These comments have been incorporated into Tables 26 and 27. The diversity of backgrounds of the reviewers making similar comments was accounted for in using the comment.

To provide an example of the process, preliminary investigation identified theme RTG5 in Table 26. Further reading, interviews and comments from reviewers identified five significant contradictions or subtle changes to the theme (RTG5, Table 27). The theme was then modified to reflect this new information. Case RCG1 (Table 28) was originally developed from four themes. These four were seen as functions of the absence of clear, rational long-term planning. Testing techniques (Section 3.2) were applied and identified the absence of a root cause for this restraining case. Reviewers' contradicting comments (Table 29) confirmed that the case was not fully developed. These comments consistently pointed to inadequate management procedures as the reason for the absence of clear, rational long-term planning.

Table 29

Summary of reviewer comments on manuscript addressing role of governmental and paragovernmental institutions in sustainable agriculture: contradicting remarks (Code = RevTrG)

Summary of comment	# and type of respondent	Utility of comment	Response (and code)
1. Too narrow a view of the problem	1; ES	L; single resp.	Change analytical framework
2. SA can not yet be implemented due to external factors/ international markets	3; 1ES,1EC 1IC	M; diverse resp.	Change analytical framework
3. Chemicals are useful and cost effective	3; 1ES,1EC 1IS	M; diverse resp. but no agroecology	Change analytical framework
4. Public policy process is the major vehicle for implementing SA	3; 1ES,1IS,1EC	M; diverse resp.	Change analytical framework
5. Intuition and scientific knowledge are important for all professionals	2; 1EC,1IC	M;	Change analytical framework
6. Distinguish the right diversification agenda from the left	1; 1EC	M;	Change analytical framework
7. You appear to argue against orderly marketing	1; 1EC	M;	Change analytical framework
8. Critize agricultural policy as economic policy as well	1; 1EC	M;	Change analytical framework
9. Focus on sustainability in ownership and control	3; 3EC	H;	Change analytical framework
10. You need a program of change with increments	3; 2EC,1IC	H;	Change analytical framework
11. Conclusions do not account for barriers discussed	4; 1ES,3EC	H;	Change analytical framework
12. The force-field analysis model is not useful	1; 1EC	M;	Change analytical framework
13. Disapprove of action research context	3; 1ES,1IS,1IC	H;	Change analytical framework
14. How do scientists, economists, technocrats decide what are legitimate values?	2; 1IS,1IC	M;	Change analytical framework
15. Focus on how SA resolves contradictions	1; 1EC	M;	Change analytical framework
16. Emphasize need to distinguish means from ends	1; 1EC	M;	Change analytical framework
17. Outline public policy process	1; 1EC	M;	Change analytical framework
18. Present your vision	1; 1EC	M;	Change analytical framework

SA=sustainable agriculture; E=external to government; I=in government; S=supporter of government; C=critic; resp.=respondent; L=low; M=medium; H=high

Table 29 (cont.)

19. Is it full vs. partial information for consumers?	2; 1IC,1EC	M;	Change analytical framework
20. You assume that people do not get what they deserve, but they do which is apathy	1; 1EC	M;	Change analytical framework
21. Real barriers to diversification tied up in search for economics of scale	1; 1EC	M;	Change analytical framework
22. Don't call for blanket cessation of government support programs because this will hurt small farms	1; 1EC	M;	Change analytical framework
23. The focus on importance of sustainability	1; 1EC	M;	Change analytical framework
24. You disregard possibility of catastrophic environmental event	1; 1EC	M;	Change analytical framework
25. Need more on change within the system	1; 1EC	M; reviewer works with internal change agents	Change analytical framework
26. Need a guide to how to use the policy-making process	1; 1EC	M; from personal experience of reviewer	Change analytical framework
27. More on tools and criteria in the solutions section	1: 1EC	M;	Change analytical framework
28. More on psychological motivating/suppressing factors	1; 1EC	M;.	Change analytical framework; addressed in redesign
29. Goals are seen similarly by bureaucrats but disagree with you on means which affects interpretation of goals	2; 2EC	M;	Change analytical framework
30. Weak sustainable agriculture goals	1; 1EC	M;	Change analytical framework
31. Don't discuss choices under tools	1; 1EC	M;	Change analytical framework
32. Lengthy inconclusive discussion of structural barriers	1; 1EC	M;	Change analytical framework
33. Lack of rational planning not necessarily a problem	2; 2EC	M;	Change analytical framework
34. Power is the key not rationality of the system	1; 1EC	M;	Change analytical framework
35. Politically simplistic	2; 1ES,1IS	M; resp. experience	Read public administration (RCG1)
36. Look more at interest groups effect on policy development	12; 1ES,5EC 3IS,3IC	H; many resp.	Read more political science
37. Examine the secret values of bureaucrats and politicians	1; 1EC	M;	Read public administration

Table 29 (cont.)

38. Information overload is a serious problem	1; 1EC	M;	Read public administration (DCG24)
39. Read management literature as applied to government	3: 2IC,1EC	H; all reviewers are concerned about subject	Read management literature (DCG1)
40. Need more from the diffusion literature	1; 1EC	M; specialist in diffusion	Read diffusion literature
41. You need to be an expert to understand decisions that may seem illogical	1; 1IS	M;	Read more management literature spoke with more bureaucrats (RCG1)
42. Externalities must be included in prices to spur on political action	1; 1ES		Already part of discussion but place more emphasis
43. Assumes SA is necessary now	2; 1ES,1EC	M;	Strengthen introduction
44. Flawed concept of sustainability; too much equation of organic with	4; 1ES,2EC,1IS	M; diverse but no agroecology	More focus on the spectrum of sustainable approaches
45. Need overview of current government programs	1; 1EC	L;	Beyond scope of thesis
46. Definition of SA too vague	1; 1EC	M;	Revisions made, examples added
47. More information on how change starts with the farmer	1; 1EC	M;	Broader than this section; restructure thesis
48. Food irradiation proponents differ on strategy not goals	2; 2EC	M;	Reduce enemy orientation; all are potential allies
49. You create a "straw man" scientist	1; 1IC	M; reviewer is a scientist	No enemies (Appendix 1)
50. Remove adversial position	2; 2EC	M;	No enemies (Appendix 1)
51. Incorrect conclusions on goal vacuum for research	1; 1EC	M;	Sought other confirming evidence, but none found
52. Profound simplicity examples not useful	1; 1EC	M;	Modify context for profound simplicity discussion
53. You don't address the issue of industrial crops	1; 1IC	M;	Identifies a boundary of study
54. Politicians do not lead	4; 1ES,2IC,1EC	H; diverse resp.	RCG5
55. Government process not as deficient as described	8; 1ES,4EC 1IC,2IS	H; many resp.	RCG1
56. There is some clear planning and goal setting	3; 1ES,1IS,1EC	M;	RCG1
57. There are many examples like the MAPAQ situation	1; 1IS	M; resp. experience	DCG18
58. Politicians must be trained and convinced to understand	5; 1ES,2IC,2EC	H; many resp.	DCG6
59. Staff training and development is first priority	2; 1EC,1IC	M;	DCG6
60. Not the system, but the players that are at fault	1; 1IC	M;	RTG6.1
61. Show how implicit food policy creates problems	1; 1EC	M;	RTG1.1
62. Middle managers do not have influence	1; 1ES	M;	RTG6.1

Table 29 (cont.)

63. Explicitly recognize role of state in supporting corporate power	1; 1EC	M;	DCG9
64. Bureaucrats cannot write a clear policy because this will not appease their masters	1; 1EC	M;	RCG1
65. Academic hostility to SA can have powerful impact on politician opinions	1; 1EC	M;	RTS25,26
66. Examine role of a supportive business lobby	1; 1EC	M;	DCA7
67. More on technology improving organic	1; 1EC	M:	DCS4
68. Public policy makers must translate public values into goals and objective	2; 1IS,1IC	M;	DCG4
69. Strategies to support interdepartmental communication are key	1; 1EC	M;	DCG1
70. Dissecting broad goal statements always identifies contradictions	1; 1EC	M;	RTG11.1
71. Middle managers can be more powerful if modifications are part of general policy thrust	1; 1IC	M; resp. experience	RTG6.1
72. Excessively harsh assessment of lack of focus of recent policy documents	1; 1IC	M; resp. experience	RTG11.1
73. Commodity-based strategies suggested in previous Ag. Can. strategy documents are not seen now to be promising	1; 1IC	M; reviewer works in Agriculture Canada	DCG14
74. Facts are not so much ignored as filtered by advisors	1; 1EC	M;	RTG3.1
75. Fertilizer Act well administered	1; 1EC	M; personal experience	RTG28.1
76. Credit problems probably due to small scale, not organic	1; 1EC	M; personal experience	RTG18.1
77. SA goals meet many more of current stated objectives of Agriculture Canada	2; 1EC,1IS	M;	RTG11.1
77. Will have to convince people that standard of living will not decline	1; 1ES	L; no agroecology	Not used
78. SA is a limited approach to feeding world	3; 2ES,1EC	L; no agroecology	Not used
79. No significant relation between food production and health; no lack of quality food	2; 1ES,1IS	L; no agroecology	Not used

Table 30

Summary of reviewer comments on manuscript addressing role of governmental and paragovernmental institutions in sustainable agriculture: confirming remarks[a] (Code = RevFiG)

Summary of comment	# and type of respondent	Utility of comment	Response (and code)
1. Emphasis is on systems rather than commodities	1; 1EC	M;	RTG11
2. The grading regulations are deficient	2; 2EC	M;	RTG21
3. There is a lack of clear policy direction	4; 2EC,1ES,1EC	H; many respondents	RTG1
4. There is a serious problem in the goals setting process	2; 1EC,1IC	M;	RTG2
5. Instruments are commonly confused with goals	1; 1EC	M;	RTG3
6. There is an absence of focus on the agricultural system for providing healthy food	2; 1EC,1IC	M;	RTG4
7. Consumer and producer objectives can be quite compatible for providing healthy food	2; 2EC	M;	RTG3
8. There is a lack of identification of bureacrats with Ag. Can.'s mission	2; 2EC	M;	RTG9
9. The role of middle management in the system and their role in creating change is well-identified	9; 5IC,3EC,1IS	H; many respondents	RTG9
10. Science and economics do operate in a subjective, value laden context	3; 2EC,1IS	M;	RTG3
11. Good understanding of policy environment and bureaucratic role is essential to pushing changes	5; 4EC,1IC	H; many respondents	RTG6
12. Current characteristics of system are not conducive to new ideas or mindset shifts	1; 1EC	M;	RTG13
13. Government is not taking SA seriously	2; 1IS,1EC	M;	RTG11
14. There lies a difficult road ahead for SA proponents	1; 1EC	M;	RTG13

SA=sustainable agriculture; E=external to government; I=in government; S=supporter of government; C=critic; resp.=respondent; L=low; M=medium; H=high

[a] Note that confirmation is often more difficult to identify than contradicting remarks. As a result, if a remark was not very clearly identified as confirming, it was not included in the analysis. Check marks or underlinings in the text were deemed insufficient. Very general confirming remarks were not included.

Table 30 (cont.)

15. Ministerial latitude does make it more difficult to set a unified course	1; 1EC	M;	RTG15
16. Incremental changes are possible within a radical change context	4; 3EC,1IC	H; many respondents	Development of general theory
17. The values behind the present policy making system are clearly identified	3; 3EC	M;	RTG11
18. Problem solving is based on reductionist thinking	1; 1EC	M;	RTG3
19. Government is reactive, not proactive	1; 1EC	M;	RTG4
20. We do need local, decentralized activity because central bureaucracies do not respond well to local needs	1; 1EC	M;	RTG20
21. The root causes of problems must be identified	1; 1EC	M;	Development of general theory
22. There are problems with using traditional scientific indicators to evaluate food quality	1; 1EC	M;	RCG2
23. Your definition of SA is very sound	2; 2EC	M;	Introductory section
24. Using examples that have worked in other jurisdictions is a good idea	1; 1EC	M;	Supports initial framework (DCG17,18,19,20,21)
25. The example of selling organic food in the British parliamentary restaurant is a good one	1; 1EC	M;	DCG18
26. Your identification of restraining factors is very good	5; 3EC,2IC	H; many respondents	Supports initial framework (RCG6,7)
27. The FCC loans go to normal farmers	1; 1IC	M;	RTG18
28. The federal Fertilizer Act is a problem	1; 1EC	M;	RTG28
29. Your identification of potential modifications is very good	3; 3EC	M;	Supports initial framework (DCG13,17,19)
30. Public policy makers do respond favourably to initiatives that are not critical of existing programs	1; 1EC	M;	Supports initial framework (DCG8,13,15,17,19,21)
31. Strategies for change do need to be beneficial to many parties	1; 1EC	M;	Supports initial framework (DCG8)
32. Profoundly simple strategies are a good idea	1; 1EC	M;	Supports initial framework

Table 30 (cont.)

33. Certification of organic food does highlight consumer information deficiencies	1; 1EC	M;	RTG29
34. A diversity of approaches are required	1; 1EC	M;	Supports initial framework
35. The example of Norway is very good	1; 1EC	M;	Supports initial framework (DCG2)

Preliminary driving cases were identified dialectically from restraining cases (Table 31). These in turn were confirmed or modified by reviewer comments (Tables 32). These cases were used to identify types and typologies (Section 4.2.2), and this process, in turn, inspired the creation of new, related driving cases (Table 32).

4.2.1.2 Research

The development of themes and cases for this area of activity developed in a similar fashion. The original themes are presented in Table 33 (and Appendix 9), modifications in Table 34, and cases in Table 35. Summary remarks from interviews (Table 20) and workshops (Table 23) are presented and incorporated in a manner outlined in Section 4.2.1.1.

Comments from reviewers are presented in Tables 36 (comments that contradict) and 37 (comments that confirm). Remarks have been incorporated into Tables 33 and 34. Driving cases have been identified in Table 38. Confirmations and contradictions are presented in Table 39.

In contrast to data collected in Section 4.2.1.1, a high degree of agreement existed in the literature regarding the problems that agricultural science presents for sustainable agriculture. In comparison with the government discussion paper, reviewers had fewer contradicting comments and remarks on the conceptual framework of the research discussion paper.

Table 31

Government driving cases (DCGs) identified dialectically from restraining cases (RCGs), from reviewer comments, and from consideration of typologies

From restraining cases

RCG1.1 Inadequate government management procedures

Driving Case (DCG) 1. Rationalize inefficient government procedures

DCG2. Retrain or bring in new staff with a different management vision

RCG2 Inadequate information gathering and evaluation tools

DCG3. New paradigms in science and economics

DCG4. Closer connection between information sources and gatherers/analysts

DCG5. Changing reward systems of information analysts/gatherers

RCG3 SA groups only have influence at certain levels

DCG6. Identify allies in the structure and exchange information and analysis

DCG7. Tailor strategy to appropriate level of decision making

DCG8. Develop mutually beneficial strategies

RCG4 Governments do not explicitly support SA as policy

DCG9. Implement an environmentally-sound food production, processing and distribution system

DCG10. Provide consumers with full information about agricultural practices

RCG5 Diffused decision-making process makes government leadership difficult

DCG11. Devolution of decision making to levels where people are affected by actions

DCG12. Change political leadership

RCG6 Many government programs, policies and regulations restrain diversification

DCG13. Modify programs and policies to remove inhibiting components

DCG14. Remove policies and programs that encourage specialization

DCG15. Use existing programs and policies to support diversification

DCG16. Create new policies and programs to encourage diversification

RCG7 Many government programs and regulations make organic production, processing and distribution more difficult

DCG17. Modify programs and regulations to remove impediments to organic

DCG18. Create new programs and regulations to encourage organic

RCG8 Many existing policies and programs have room for SA components

DCG19. Modify programs to permit fuller access to SA practitioners

DCG20. Create new programs and regulations to support SA

DCG21. Create specific SA components within existing programs

From the development of typologies

DCG22. Redesign the food system around the optimal diet

DCG23. Wean Canada from the import/export economy

Table 32
Confirmation and contradiction of government driving cases

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCG1	Beaubien, 1986; Plumptre, 1988; Jackson, 1988	RevCtG38,39,69; Wright, 1989 Walters & Hollings, 1984; Ulrich & Wiersema, 1989; Morgan, 1989a; Solway, 1988	(A) Completely redesign the organization of government units	DCG24 7/89
DCG2	Beaubien, 1986; Plumptre, 1988; Jackson, 1988			
DCG3	See Section 5.2			
DCG4	RevTrG68; Walters & Holling, 1984; Solway, 1988; Morgan, 1989a			
DCG5	Plumptre, 1988; See Section 5.2			

Codes: D=Driving; C=Case; G=Government; Rev=Reviewer; W=Workshop; I=Interview; Tr=Contradicting comments; Fi=Confirming comments

Table 32 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCG6	W.Wi89.G15,G16			
DCG7	W.Wi89.G16			
DCG8	RevFiG30,31; W.Wi89.G16			
DCG9		RevTrG63; W.Wi89.G12; W.Wg88.G19; Ekins, 1986a; Bookchin, 1989; Bonanno, 1987; Robertson, 1983; Henderson, 1981; Mitchell, 1975	(A) Change the role of state in agricultural development	DCG25 7/89
DCG10	W.Or88.G24; Singer, 1986; Pollution Probe, 1989; Will et al., 1988; Norwegian Ministry of Agr., 1975			

Codes: D=Driving; C=case; G=government; Rev=Reviewer; W=workshop; I=interview;
Tr=Contradicting comments; Fi=Confirming comments

Table 32 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCG11	Friedmann, 1981; Satin, 1978; Barber, 1984; Benello and Roussopoulos, 1971			
DCG12	DeMarco, 1989			
DCG13	RevFiG29,30: I.An88.G15; Ward et al., 1989			
DCG14	RevTrG73: I.An88.G15; W.Or88.G22,G27			
DCG15	RevFiG30; W.Or88.G29; I.An88.G15; W.Wi89.G13			

Codes: D=Driving; C=Case; G=Government; Rev=Reviewer; W=Workshop; I=Interview; Tr=Contradicting comments; Fi=Confirming comments

Table 32 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCG16	I.An88.G15; W.Wi89.G13 W.Wg88.G19; Goldsmith, 1988			
DCG17	RevFiG24,29,30; I.La89.G6; I.Ze88.G13; W.Wi89.G13			
DCG18	RevTr57; RevFiG24,25; I.Ze88.G13; I.Ho89.G50; I.La89.G44;W.Wi89.G13; W.Or88.G23,G25	I.La89.G29; Midmore & Lampkin, 1988; Rundgren, 1989; Swanson et al., 1986	(V) Create the programs and regulations to encourage organic, but subsidies may not be appropriate	DCG18.1 7/89
DCG19	RevFiG24,29,30; I.La89.G43,G45; W.Wi89.G13	RevTrG58,59; I.La89.G41,G42; W.Wi89.G14; W.Or88.G14	(A) Politician and staff training in SA is essential	DCG26 7/89
DCG20	RevFiG24; I.Cd88.G37; I.La89.G44; W.Wi89.G13			

Codes: D=Driving; C=Case; G=Government; Rev=Reviewer; W=Workshop; I=Interview; Tr=Contradicting comments; Fi=Confirming comments

Table 32 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCG21	RevFiG24,30; I.Kk89.G33,G34; I.La89.G44; I.Sn89.G51; W.Wi89.G13; W.Or88.G21			
DCG22	SCC, 1979; Milio, 1988; Ringen, 1977; Winikoff, 1977; Gussow & Clancy, 1986; Herrin & Gussow, 1989; Grimme et al., 1986			
DCG23	Warnock, 1982, 1984; Harnapp, 1988 Kneen, 1989a; Meeker-Lowry, 1988; Rocky Mountain Institute, 1986a			
DCG24				
DCG25				

Codes: D=Driving; C=Case; G=Government; Rev=Reviewer; W=Workshop; I=Interview; Tr=Contradicting comments; Fi=Confirming comments

Table 33
Examples of preliminary themes: research restraining forces (barriers)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence	Used for which case?
1. Most agricultural scientists are not doing research useful to SA	RTS1 2/87	Hill, 1984a; Kramer, 1984	Robinson, 1985; 1986; Baker & Smith, 1987; Blobaum, 1983; I.Ho89.S1,S3; I.Cd88.S24; I.Fi88.S21,S22; I.Ca88.S4; I.An88.S7; RevFIS1	RCS1
2. Development of a community of professional scientists narrowed the field of scientific view	RTS2 3/87	Kuhn, 1970	Mahoney, 1976; Busch, 1980; Bahm, 1979; Capra, 1982; RevFIS9	RCS2
3. Most agricultural scientists see solutions in discrete products and technologies	RTS3 3/87	Albury & Schwartz, 1982; Heffernan, 1986	Levins & Lewontin, 1985; Hadwiger, 1982; Doyle, 1985; OTA, 1986; Buttel, 1986a; Hall, 1974; Vogeler, 1981; RevFIS9	RCS2
4. Not possible to integrate "bits" of disparate research into a comprehensible picture	RTS4 3/87	Miller, 1985a; Busch & Lacy, 1983	Hanway, 1978; Suzuki; 1987; Capra, 1982 W.Wi89.S7; RevFIS9	RCS2
5. Elaborate assumptions required to explain how diverse biological systems can be treated similarly	RTS5 4/87	Bennett, 1986; Miller, 1985a	Dundon, 1982; Capra, 1982	RCS2

Code: R=Restraining; T=Theme; S=Research; Rev=Reviewer; Fi=Confirming comment; W=Workshop; I=Interview
See Appendix 9 for a full listing of themes

Table 34
Examples of modifications to preliminary themes: research restraining forces (barriers)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and date	Used for which case?
14. Long history of agricultural scientists sharing interests of capitalist class	1. Not capitalism but modern industrial society that is the problem 2. A narrow definition of economic efficiency is used 3. Agricultural science has not sold out to commercialism	1. RevTrS14 2. RevTrS14 3. RevTrS4	Agricultural scientists have traditionally shared dominant ideas of modern industrial society	RTS14.1 10/88	RCS4
23. Selective use or outright fabrication of data or results occurs	Scientist self-delusion is mostly naive and well-intentioned	RevTrS13	Selected distortion is usually not a conscious level	RTS23.1 10/88	RCS3
24. Many scientists design experiments to confirm already held beliefs	Scientist self-delusion is mostly naive and well-intentioned	RevTrS13	Manipulation of experimental design is not usually done at a conscious level	RTS24.1 10/88	RCS3
30. Peer review process for funding and publication is weakened by personal biases of reviewers	1. Peer review works well if a good journal editor 2 Works well if a large pool of reviewers to draw on	1. W.Sb89.S40 2. Cole et al., 1981	Publication peer review works well under ideal conditions that neutralize biases of individuals	RTS30.1 10/89	RCS3 RCS8

Code: R=Restraining; T=Theme; S=Research; C=Case; Rev=Reviewer; Tr=Contradicting comment; I=Interview; W=Workshop

Table 35
Research restraining cases created from restraining themes

Cases	1. Canadian research and teaching facilities are slowly developing programs in SA	2. Reductionist, positivist approaches dominate present day agricultural science	3. Scientists believe in objectivity and do not recognize the positive and negative effects of values and emotions on science
Code and date	RCS1 4/90	RCS2 7/87	RCS3 7/87
Supporting themes and comments	RTS1; RTS34	RTS2; RTS3; RTS4; RTS5; RTS6; RTS7; RTS10; RTS11; RTS12;	RTS8; RTS9; RTS18; RTS19; RTS23.1; RTS24.1; RTS30.1
Nature of relationship	Cumulative	Functional	Symptom and source
Result of testing	o.k.	o.k.	o.k.
Contradicting information			
Revised case			
New code and date			

Codes: R=Restraining; C=Case: S=Research

Table 35 (cont.)

Cases	4. Training and institutional environment contribute to a narrow world view on the part of many agricultural scientists	5. Administrative divisions make SA research more difficult to conduct	6. Reward systems do not reward SA efforts as readily as conventional research
Code and date	RCS4 7/87	RCS5 7/87	RCS6 7/87
Supporting themes and comments	RTS14.1; RTS15; RTS16; RTS17	RTS33	RTS13; RTS20; RTS31; RTS32
Nature of relationship	Cause and effect	Cause and effect	Symptom and source
Result of testing	o.k.	o.k.	o.k.
Contradicting information			
Revised case			
New code and date			

Codes: R=Restraining; C=Case: S=Research

Table 35 (cont.)

Cases	7. Disciplines have strong influence on scientific behaviour	8. Funding mechanisms restrain development and implementation of SA programs	9. Clear goals for agricultural rosearch are not being set and coordinated by public agricultural institutions
Code and date	RCS7 7/87	RCS8 7/87	RCS9 7/87
Supporting themes and comments	RTS21; RTS22	RTS27; RTS28; RTS29; RTS30.1	RTS25; RTS26; RTS27
Nature of relationship	Functional	Cause and effect	Cause and effect
Result of testing	o.k.	o.k.	o.k.
Contradicting information			
Revised case			
New code and date			

Codes: R=Restraining; C=Case; T=Theme; S=Research

Table 36

Summaries of reviewer comments on manuscript and poster session addressing research institution involvement in sustainable agriculture: contradicting comments (Code=RevTrS)

Summary of comment	# and type of respondent	Utility of comment	Response
1. Don't define the SA research agenda by what it is not	1; 1IC	M;	Change analytical framework No enemies (Appendix 1)
2. Reductionism has some uses; refuting it does not prove holism	2; 2IC	M;	DCS33
3. A diversity of scientific approaches is required for SA	2; 2IC	M;	DCS33
4. Agricultural science has not sold out to commercialism but has been used for nefarious purposes	1; 1IC	M;	RTS14.1
5. Science works on a ratchet effect and what is gained is not lost (philosophy often works the other way round)	1; 1IC	M;	DCS33
6. Need more on how agricultural systems fit into a larger ecology	1; 1IC	M;	Addressed in Sections 1.0, 2.0
7. Private sector multi-disciplinary teams can work well; have to out of necessity	1; 1EC	M;	DCS13
8. Time frame of proposed solutions too long; need immediate changes	1; 1EC	M;	Change analytical frawework
9. No amount of research will help a farmer who has lost a farm (need parity prices based on quality)	1; 1EC	M;	Change analytical framework
10. Holistic inquiry not clearly operational	2; 2IC	M;	Change analytical framework
11. SA must be proven viable to farmers	1; 1IC	M;	Addressed in Section 2.0
12. Changing funding criteria will take some time	1; 1IC	M;	Change analytical framework
13. Too much emphasis on the negative side of agricultural scientists; many are idealistic and hardworking; naive self-delusion more common than cynicism	1; 1IC	M;	No enemies (Appendix 1) RTG23.1,24.1

Code: R=Restraining; D=Driving; T=Theme; C=Case; IC=Internal Critic; EC=External Critic; M= Medium; S=Research

Table 36 (cont.)

14. Science interacts more with modern industrial society than with capitalism	1; 11C	M;	RTG14.1
15. Scientists accept a narrow economic definition of efficiency rather than a capitalist one	1; 11C	M;	RTG14.1
16. Medium-term goals are interesting, but incomplete	1; 11C	M;	Section 5.1.3, context changed
17. Keep the focus on food systems, not just production	1; 11C	M;	Change analytical framework

Table 37

Summaries of reviewer comments on manuscript and poster session addressing research institution involvement in sustainable agriculture: confirming comments (Code=RevFiS)

Summary of comment	# and type of respondent	Utility of comment	Response
1. Discussion of Type II statistical errors is important	1; 1EC	M;	RTS12
2. There are difficulties doing interdepartmental work	1; 1EC	M;	RTS32,33
3. At times, facilitators for research teams would be very useful	1; 1EC	M;	DCS9
4. Long and medium term SA goal statements are very useful	2: 1EC,1IC	M;	Section 5.1.3
5. Important to penetrate institutions with recruits having an SA vision	1; 1EC	M;	DCS5
6. Solutions are attractive but need to be more realizable	1; 1EC	M;	Change analytical framework
7. A diversity of scientific approaches are required	1; 1EC	M;	DCS33
8. The focus of conventional agricultural research is misplaced	1; 1EC	M;	RTS1
9. Conventional research methods are inappropriate (reductionism, self-serving research)	1; 1EC	M;	RTS2,3,4,13,21,23
10. Good solutions for helping scientists put ecology into their work	1; 1IC	M;	DCS10
11. Good conclusions on how administrators must change	1; 1IC	M;	DCS12
12. Good suggestions for changing education	1; 1IC	M;	DCS10,32
13. Good dissection of the strengths, weaknesses and assumptions of agricultural science and its institutions	1; 1IC	M;	All RTS

Code: R=Restraining; D=Driving; T=Theme; C=Case; IC=Internal Critic; EC=External Critic; M= Medium; S=Research

Table 38

Research driving cases (DCSs) identified dialectically from restraining cases (RCSs), from reviewer comments and from consideration of typologies

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From restraining cases

RCS1 Canadian research and teaching facilities are slowly developing programs in sustainable agriculture

Driving cases (DCS):

1. Develop distinct SA research and training programs
2. Incorporate SA into all research and teaching programs
3. Add SA components to research and teaching programs
4. Follow SA research agenda and match methodologies to level of investigation and topic
5. Hire people trained in and committed to SA

RCS2 Reductionist, positivist approaches dominate present day agricultural science

Driving cases:

6. Use new paradigms for SA investigation
7. Develop more on-farm research programs
8. Develop research impact assessments

RCS3 Scientists believe in objectivity and do not recognize the positive and negative effects of emotions and values on science

Driving cases:

9. Use facilitators/coordinators to help identify and resolve emotional and interpersonal difficulties

RCS4 Training and institutional environment contribute to a narrow world view on the part of many agricultural scientists

Driving cases:

10. Broaden scientific training
11. Develop SA retraining programs

RCS5 Administrative divisions make SA research more difficult to conduct

Driving cases:

12. Design administrative units around SA research areas
13. Create trans-departmental project units

RCS6 Reward systems do not reward SA efforts as readily as conventional reserach

Driving cases:

14. Reward activities that contribute to SA
15. Reward more than just publication record
16. Emphasize evaluation of research and teaching methodologies not results
17. Develop collaborative evaluation process involving administrators and scientist being evaluated

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Table 38 (cont.)

RCS7 Disciplines have strong influence on scientist behaviour

Driving cases:

18. Publish in SA journals
19. Broaden the peer review process
20. Broaden disciplinary education

RCS8 Funding mechanisms restrain development and implementation of SA programs

Driving cases:

21. Agribusiness firms pay for research that benefits them
22. Government funds basic long-term research
23. Participatory research partly funded by co-participants
24. Funding guaranteed for longer time periods
25. Funding agencies rework criteria and structure to support innovation and creativity
26. Provide more funding to projects to identify key research areas and research policy
27. Establish funding mechanisms specifically for SA
28. Broaden the funding peer review process

RCS9 Clear goals for agricultural research are not being set and coordinated by public agricultural institutions

Driving cases:

29. Establish clear publicly determined SA goals and research priorities and design systems for research institution compliance

From the development of typologies

Driving cases:

30. Provide opportunities for regular counselling for scientists
31. Identify values, biases and emotions in the scientific reporting process
32. Change pedagogy of agricultural curricula

Table 39
Confirmation and contradiction of research driving cases

Driving case code	Confirmation or examples	Contradictions	Revised (V) or additional (A) case	Code and date
DCS1	W.Sb89.S24; W.Wi89.S8,S9; W.Sh88.S14	W.Sh88.S19,S27	(V) Need research, extension and teaching programs	DCS1.1 10/88
DCS2	W.Wi89.S8,S9; W.Sh88.S14			
DCS3	W.Wi89.S8,S9; W.Sh88.S14			
DCS4	I.Kl88.S5,S6; I.An88.S8,S9; I.La89.S11; W.Wi89.S8; W.Sh88.S12,S18; USDA, 1980; Harwood & Madden, 1962; Maslow, 1966; Aiken, 1986; Lockeretz, 1985; Francis & Sahs, 1988; RevTrG67			
DCS5	I.Gi88.S18; RevFi65			

Codes: D=Driving; C=Case; S=Research; Rev=Reviewer; W=Workship; I=Interviewer; Tr=Contradicting comments; Fi=Confirming comments

Table 39 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or additional (A) case	Code and date
DCS6	W.Wi89.S8; W.Sh88.S17; Patriquin et al., 1986; Reason & Rowan, 1981a; Rogers, 1985; Bortolt, 1986	RevTrS2,3,5; W.Le88.S4,S5; RevFiS7	(V) New paradigms address broader synthetic issues and reductionist approaches help flesh out details	DCS6.1 10/88
DCS7	I.An88.S10; W.Le88.S6; W.Wi89.S8; W.Sb89.S24; W.Sh88.S15,S16,S20,S21,S23; Thompson & Thompson, 1985; Krome, 1988			
DCS8	Madden, 1978; Conway, 1986; Friedland & Kappel, 1979	Busch, 1984	(V) Must be applied early to ensure that the assessment is not too late to change the experiment	DCS8.1 7/87
DCS9	RevFiS3; Miller, 1984; Caye & Sachs, 1982; Reason & Rowan, 1981b			
DCS10	W.Wi89.S9; W.Sh88.S14; RevFiS10,S12; Kuhn, 1970; Dundon, 1982; Miller, 1984; Hart, 1986; Conway, 1986			

Codes: D=Driving; C=Case; S=Research; Rev=Reviewer; W=Workship; I=Interviewer; Tr=Contradicting comments; Fi=Confirming comments

Table 39 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or additional (A) case	Code and date
DCS11	I.Gi88.S13; W.Wi89.S9; W.Sh88.S14			
DCS12	W.Wi89.S8; RevFiS11; W.Sb89.S31; Gouvernement du Quebec, 1979			
DCS13	W.Wi89.S8; RevTrS7; Friedland & Kappel, 1979; Madden, 1986a			
DCS14	I.Ma89.S26; I.Gi88.S15; W.Sb89.S34			
DCS15	W.Sb89.S25,S34,S35; Gouvernement du Quebec, 1979; Manwell & Baker, 1986; Busch & Lacy, 1983			

Codes: D=Driving; C=Case; S=Research; Rev=Reviewer; W=Workship; I=Interviewer; Tr=Contradicting comments; Fi=Confirming comments

Table 39 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or additional (A) case	Code and date
DCS16	Mahoney, 1976; Truzzi, 1979			
DCS17				
DCS18	I.Ma89.S28			
DCS19	I.Ma89.S29; W.Sb89.S26; Mahoney, 1976; Savan, 1988			
DCS20	See DCS10			

Codes: D=Driving; C=Case; S=Research; Rev=Reviewer; W=Workship; I=Interviewer; Tr=Contradicting comments; Fi=Confirming comments

Table 39 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or additional (A) case	Code and date
DCS21	W.Sb89.S32; Hightower, 1972; Friedland & Kappel, 1979; Marshall, 1980; Busch & Lacy, 1983			
DCS22	Buttel, 1986a; Hansen et al., 1986			
DCS23	W.Sh88.S22; Fineman, 1981; Groh, 1985			
DCS24	W.Sb89.S37,S39; Muller, 1980; Busch & Lacy, 1983			
DCS25	I.Gi88.S16; W.Sb89.S28; Muller, 1980			

Codes: D=Driving; C=Case; S=Research; Rev=Reviewer; W=Workship; I=Interviewer; Tr=Contradicting comments; Fi=Confirming comments

Table 39 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or additional (A) case	Code and date
DCS26	Freudenberger, 1986			
DCS27	I.Gi88.S19; I.Ma89.S25; W.Wi89.S8			
DCS28	W.Sb89.S26,S43			
DCS29	I.Gi88.S12,S17; W.Wi89.S8; Gouvernement du Quebec, 1979	I.Gi88.S14;,S20; W.Sb89.S33; W.Sh88.S21	(V) Public interest groups, farmers and students have a role to play in setting and monitoring goals	29.1 7/89
DCS30	Maslow, 1966; Hill, 1987; Reason & Rowan, 1981b			

Codes: D=Driving; C=Case; S=Research; Rev=Reviewer; W=Workship; I=Interviewer; Tr=Contradicting comments; Fi=Confirming comments

Table 39 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or additional (A) case	Code and date
DCS31	Miller, 1987; Mahoney, 1976			
DCS32	RevFiS12; Romey, 1976; de Rosnay, 1979; Bawden et al., 1984			

Codes: D=Driving; C=Case; S=Research; Rev=Reviewer; W=Workship; I=Interviewer; Tr=Contradicting comments; Fi=Confirming comments

4.2.1.3 Agribusiness

The process for developing themes and cases for this section differed from that of the first two areas. Very few data were collected for this section before the explanatory scheme (general theory) evolved. The same kinds of data sources were used (literature, interviews, workshops), but the data collection was more focussed because I had a better idea of what I was seeking.

Themes are presented in Table 40 (and Appendix 10), modifications in Table 41 (and Appendix 11), and cases in Table 42. Summary remarks from interviews (Table 21) and workshops (Table 24) are presented and incorporated in the manner described in Section 4.2.1.1. Reviewer remarks are presented in Tables 43 (contradicting) and 44 (confirming). Driving cases are identified in Table 45. Confirmations and contradictions are presented in Table 46.

Of all discussion documents or presentations, the agribusiness one generated the most extreme reactions amongst reviewers (Tables 43 and 44). There appear to be two reasons for this. First, the negative impacts of large agribusiness firms on agriculture are perceived by many to be the most difficult to overcome. Several reviewers did not believe that an evolutionary approach, as presented in the discussion paper, would lead to significant improvements. They forsaw the need for more cataclysmic or revolutionary action. Others indicated that an evolutionary approach was the most desirable, but were pessimistic regarding the amount of time involved in pursuing the strategies proposed. Second, the differences in worldviews of reviewers were most clearly expressed in this area. Many reviewers with training in economics were very opposed to the paradigm

Table 40

Examples of preliminary themes: agribusiness restraining forces (barriers)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence	Used for which case?
1. Corporate concentration in agrifood sector higher than other industrialized nations	RTA1 6/90	Mitchell, 1975; Warnock, 1978; White, 1990	Francis, 1986; Khemani, 1988; Hazledine, 1989 I.GI88.A19,A21; RevFIA4	See Table 41
2. Corporate concentration causes farmer cost/price squeeze	RTA2 6/90	Strange, 1988a; Vogeler, 1981; Warnock, 1978	Warnock, 1979; Greene, 1976; Coffin, 1987; W.Wg88.A11; RevFIA4	RCA1
3. Corporate concentration produces higher consumer retail prices	RTA3 6/90	Parker & Connor, 1987; Marion et al., 1979; Mitchell, 1975	Warnock, 1978; Lerza & Jacobsen, 1975; RevFIA4	RCA1
4. Concentration results in less diversity of farms, rural business and services	RTA4 6/90	Vogeler, 1981; Mitchell, 1975	Kneen, 1990; Warnock, 1978; Coffin, 1987; W.Le88.A5; RevFIA4	RCA1,4
5. Corporations and government exchange senior employees, and represent a network of friendships	RTA5 6/90	Porter, 1965; Newman, 1979; Francis, 1986; McQuaig, 1987	Stanbury, 1988; Davies, 1987; W.WI89.A7 RevFIA4	RCA2

Code: R=Restraining; T=Theme; A=Agribusiness; Rev=Reviewer; FI=Confirming comment

See Appendix 10 for a full listing of themes

Table 41
Modifications to preliminary themes: agribusiness restraining forces (barriers)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and date	Used for which case?
1. Corporate concentration in agrifood sector higher than other industrialized nations (RTA1)	Yes, but implications not really clear because of methodological problems	Khemani et al., 1988; Marion et al., 1979; Francis, 1986; Hazledine, 1989	Corporate concentration is high in Canada but disagreement exists regarding the implications	RTA1.1 6/90	RCA1
2. Corporate concentration causes farmer cost/price squeeze (RTA2)					
3. Corporate concentration produces higher consumer retail prices (RTA3)					
4. Concentration results in less diversity of farms, rural business and services (RTA4)					
5. Corporations and government exchange senior employees, and represent a network of friendships (RTA5)					

Code: R=Restraining; T=Theme; A=Agribusiness; Rev=Reviewer; Tr=Contradicting comment

Table 42
Agribusiness restraining force cases created from restraining force themes

Cases	1. Corporate concentration results in control and dependency in agrifood sector	2. Large corporations exert excessive influence over the political process	3. Specialization and centralization associated with agri-business results in declining food and environmental quality
Code and date	RCA1 6/90	RCA2 6/90	RCA3 6/90
Supporting themes and comments	RTA1.1; RTA2; RTA3; RTA4	RTA5	RTA6; RTA7
Nature of relationship	Causal	Means and ends	Causal
Results of testing	o.k.	o.k.	o.k.
Contradicting information			
Revised case			
New code and date			

Codes: R=Restraining; C=Case; A=Agribusiness; Rev=Reviewer; Tr=Contradicting comments

Table 42 (cont.)

Cases	4. Agribusiness activity results in rural community decline	5. Private and public financing of large firms limits ability to finance SA	6. Economic analyses do not take SA principles into account
Code and date	RCA4 6/90	RCA5 6/90	RCA6 6/90
Supporting themes and comments	RTA4; RTA8; RTA9	RTA10; RTA11; RTA12; RTA13	RTA19; RTA20; RTA21; RTA22; RTA23
Nature of relationship	Functional	Functional	Means and ends
Results of testing	o.k.	o.k.	o.k.
Contradicting information			
Revised case			
New code and date			

Codes: R=Restraining; C=Case; A=Agribusiness; Rev=Reviewer; Tr=Contradicting comments

Table 42 (cont.)

Cases	7. Information control permits large firms to outcompete and to manipulate consumers	8. Characteristics of and regulations governing corporations discourage SA	9. Ownership of corporations is not widely or democratically held
Code and date	RCA7 6/90	RCA8 6/90	RCA9 6/90
Supporting themes and comments	RTA8; RTA14; RTA15	RTA16; RTA17	RTA18
Nature of relationship	Means and ends	Functional	Causal
Results of testing	o.k.	o.k.	o.k.
Contradicting information			
Revised case			
New code and date			

Codes: R=Restraining; C=Case; A=Agribusiness; Rev=Reviewer; Tr=Contradicting comments

Table 43

Summary of reviewer comments on manuscript addressing role of agribusiness in sustainable agriculture: contradicting remarks (Code = RevTrA)

Summary of comment	# and type of respondent	Utility of comment	Response (and code)
1. Not a good action agenda	2; 2EC	M;	Misunderstanding of purpose
2. You do not account for commodity futures and global tariff issues	1; 1EC	M;	Beyond scope of thesis
3. Agribusiness activity is a symptom of a societal values problem	1; 1EC	M;	Modified
4. Linkage of advertising to rural depopulation is weak	1; 1EC	M;	Stengthened
5. Strengthen point that efficiency and substitution changes will likely be seen as adequate by society until they are thoroughly discredited	1; 1EC	M;	Addressed in Section 4.2.2
6. Transnational control will only be weakened by changing international politics	1; 1EC	M;	Beyond scope
7. Strengthen the point that efficiency and substitution strategies can be coopted	1; 1EC	M;	Addressed in Section 4.2.2
8. Cost/price squeeze is the heart of the problem	1; 1EC	M;	Disagree. Is a symptom
9. Strengthen how rural decline results from centralization: transport, advertising, withdrawal of government services	1; 1EC	M;	Strengthened
10. Explain ecological rationality	1; 1EC	M;	Done
11. Corporate greening is largely clever rhetoric	2; 2EC	M;	DCA7.1
12. Needs more on empowering consumers as agents of change	1; 1EC	M;	Strengthened
13. Don't think efficiency category is well defined	1; 1EC	M;	Discussed in Section 4.2.2
14. Legal changes to corporations and shareholder activity are not likely to be implemented by government or agribusiness	2; 2EC	M;	Acknowledged in text
15. Many proposals will not be supported by the establishment	2; 2EC	M;	Acknowledged in text
16. Don't assume that only a few are interested in SA	1; 1EC	M;	Context modified

SA=sustainable agriculture; E=external to agribusiness; I=in agribusiness; S=supporter of agribusiness; C=critic; resp.=respondent; L=low; M=medium; H=high

Table 43 (cont.)

17. Emphasize cooperation in redesign	1; 1EC	M;	Changed
18. You have trouble making the transition from liberal ranting to constructive suggestions	1; 1EC	M;	Changed
19. Include corporate redesign in the redesign section	1; 1EC	M;	Considered, but rejected
20. Make centralization more explicitly the source of the problem	1; 1EC	M;	Changed
21. More emphasis on the irrationality of transportation systems	1; 1EC	M;	Beyond scope of thesis
22. Biases of the state and universities are major problems	1; 1EC	M;	Discussed in Sections 5.1 and 5.2
23. Insufficient discussion of free trade impacts	1; 1EC	M;	Beyond scope of thesis
24. Insufficient discussion of the land tenure system and the power of the banks	1; 1EC	M;	Beyond scope of thesis
25. More on grading standards	1; 1EC	M;	Discussed in Section 5.1.3.2.2
26. More on direct marketing	1; 1EC	M;	Discussed in Sections 1.5 and 2.5
27. Insufficient attention to redesign	2; 2EC	M;	Strengthened
28. Restructuring mergers and acquisitions may not do much for SA	1; 1EC	M;	Acknowledged in text
29. A green government is required for many of these things to happen	1; 1EC	M;	Beyond scope of thesis
30. Links between different strategies and sustainability are not always clear	3; 1EC,2ES	H; many respondents	Strengthened
31. Need a timeline for the projected transition	1; 1EC	M;	Beyond scope of thesis
32. Make rebuttal of selling organic through conventional system stronger	1; 1EC	M;	Strengthened
33. The cooperative structure is not at fault, but rather its failure to address oligopolistic control of distribution	1; 1EC	M;	Modified
34. More on decommodification	1; 1EC	M;	Acknowledged in redesign section
35. You present agribusiness as whipping boys	1; 1ES	M;	Language changed

Table 43 (cont.)

36. Corporate concentration is a serious problem, but is a response to economic incentives and government pressure	1; 1ES	M;	Agree; explains the need for redesign of economics
37. You assume farmers are the good guys	1; 1ES	M;	Disagree
38. Remember that farmers are very subsidized also	1; 1ES	M;	Discussed in Section 5.1
39. Most of your remedies are not specific to agriculture	1; 1ES	M;	Agreed; text modified
40. Little presentation of alternative business behaviour theory	1; 1ES	M;	Identified in discussion as not part of discussion
41. Environmentalists will have to cut deals with the capitalist establishment	1; 1EC	M;	Beyond scope of thesis
42. Ethical investment lacks standards and monitoring	1; 1EC	M;	DCA15.2
43. Advertising has significant informational value	1; 1ES	L; no agroecology	Not used
44. Analysis is naive in extreme with a completely different world view	1; 1ES	L; no agroecology	Not used
45. Farmers have too much political clout and this is a major source of agricultural problems	1; 1ES	L; no agroecology	Not used
46. Very poor discussion of corporate concentration	1; 1ES	L; no agroecology	Not used
47. Your style is polemical	1; 1ES	L; no agroecology	Not used
48. Do not find sufficient evidence that agribusiness is a barrier	1; 1ES	L; no agroecology	Not used
49. Consumers should be able drive the system	1; 1ES	L; no agroecology	Not used; conditions for consumer sovereignty do not exist
50. Needs aré no more important than wants	1; 1ES	L; no agroecology	Not used
51. The thread of your argument is irretrievably knotted	1; 1ES	L; no agroecology	Not used

Table 44

Summary of reviewer comments on manuscript addressing role of agribusiness in sustainable agriculture: confirming remarks (Code = RevFiA)

Summary of comment	# and type of respondent	Utility of comment	Response (and code)
1. Strong support for the ESR framework	4; 4EC	M; many respondents	Confirms explanatory scheme
2. We do need a systemic challenge to agribusiness power	2; 2EC	M;	Confirms explanatory scheme
3. Good integration of health, economy and environment	2; 2EC	M;	Confirms analysis
4. Good discussion of corporate concentration	3; 3EC	M; mitigated by lack of diverse respondents	RTA1,2,3,4,5
5. Good discussion of matching information power, consumer activism and corporate liability	1; 1EC	M;	DCA5,14,19
6. Agribusiness practices do contradict the needs of organic producers	1; 1EC	M;	RTA6,7,9
7. Consumer consciousness can lead to meaningful changes	1; 1EC	M;	DCA5,6,15
8. We do need a reorganization of economics	3; 3EC	M; mitigated by lack of diverse respondents	DCA12
9. Consumers do not receive full information	1; 1EC	M;	RTA14
10. Most organizations are run by management autocracies	1; 1EC	M;	RTA16
11. Yes, the board should control management	1; 1EC	M;	DCA17
12. Eliminating corporate power is essential to creating a more supportive environment for diverse activities	1; 1EC	M;	Confirms analysis
13. Good discussion of opportunity costs associated with capital	1; 1EC	M;	RTA10
14. The need for locally structured markets is appropriate	1; 1ES	M;	DCA8,12
15. Good job of finding sources to support your argument	1; 1ES	M;	Confirms research effort
16. Advertising does manipulate consumers	1; 1EC	M;	RTA14
17. Corporations do lack public accountability	1; 1EC	M;	RTA16,17,18
18. Agree that economic concepts do not recognize ecological realities	1; 1EC	M;	RTA20,21,22,23

SA=sustainable agriculture; E=external to agribusiness; I=in agribusiness; S=supporter of agribusiness; C=critic; resp.=respondent; L=low; M=medium; H=high

Table 44 (cont.)

19. Agribusiness firm activity in organic will compromise its objectives	1; 1EC	M;	DCA7.1
20. Size limitations on corporations are critical to success	1; 1EC	M;	DCA18

Table 45
Agribusiness driving cases identified dialectically from restraining cases, from reviewer comments, and from consideration of typologies

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From restraining cases:

RCA1
Driving cases:
DCA1 Legislation to restrict mergers and acquisitions
DCA2 Legislation to force divestitures
DCA3 Creation of structures to confront corporate power

RCA2
Driving cases:
DCA4 Restructuring of Boards of Directors of corporations, and their role

RCA3
Driving cases:
DCA5 Consumers buy products, such as organic foods, based on environmental and health criteria
DCA6 Consumers do not purchase or boycott undesirable products
DCA7 Organic foods and "green" products are sold through conventional distribution system
DCA8 Redesign economic analyses to value local and regional production
DCA9 Eliminate products that are hazardous to health and the environment

RCA4
Driving cases:
DCA10 Change tax system to remove subsidies to agribusiness
DCA11 Eliminate direct public subsidy of large agribusiness firms
See DCA1

RCA5
Driving cases:
DCA12 Redesign economic concepts to make them consistent with ecological realities (see DCA8)
DCA13 Communities create alternative enterprises based on SA principles

RCA7
Driving cases:
DCA14 Create equivalent intelligence networks
DCA15 Provide opportunities for full-information purchase and investment decisions by consumers
DCA16 Establish codes of conduct for business activity and behaviour
See also section 5.1.3.2.2

RCA8
Driving cases:
DCA17 Democratize shareholder control
DCA18 Change legal status of corporation so that it better reflects original purpose

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Table 45 (cont.)

<u>RCA9</u> Driving cases: DCA19 Increase shareholder, director and management liability DCA20 Government encourages the diversification of share ownership

Table 46
Confirmation and contradiction of agribusiness driving cases

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCA1	Nader et al., 1976; Satin, 1987b; Mintz & Cohen, 1976; Goldman, 1988; W.Wg88.A21			
DCA2	Goel, 1990; Pound, 1989; W.Wg88.A21			
DCA3	Coffin, 1987; Kneen, 1990; Gertler, 1981; W.Wg88.A20,A21			
DCA4	Nader et al., 1976; Mintz & Cohen, 1976;			
DCA5	Stoney, 1987; Baseline Market Research, 1988; Peter & Ghesquiere, 1988; Jolly et al., 1989; RevFIA5,7			

Codes: D=Driving; C=Case; A=Agribusiness; Rev=Reviewer; W=Workshop; I=Interview; Tr=Contradicting comments; FI=Confirming comments

Table 46 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCA6	W.Wg88.A19; RevFIA7 W.Or88.A3; Anon., 1989f; Meeker-Lowry, 1988			
DCA7	I.Ze88.A9; Hill, 1986a; Boutet, 1989; Gregoire & Rocq, 1988; RevTrG66	W.Wg88.A22,A23; I.Br88.A1,A2; I.Kl89.A3,A4,A5 I.Co88.A6; I.Sc88.A7,A8; I.Sw89.A10,A11; Bird, 1988; Hunt, 1989; Davis, 1989; Kohl, 1990; Hall et al., 1989; COG, 1990; Marder, 1990; Goldstein, 1990; Daguet, 1989/90; RevFIA19; RevTrA11	(V) Distribution in conventional system limited by organic market immaturity, the different qualities of the organic product, poor understanding of organic in the conventional system, and the lack of verification procedures for green products	DCA7.1 6/90
DCA8	Schumacher, 1973; Robertson, 1983; Henderson, 1981; RevFIA14			
DCA9	I.Gl88.A15; Epstein, 1989; Griffith, 1989; Siedenburg, 1989; Marquardt, 1989a			
DCA10	Kierans & Stewart, 1988; McQuaig, 1987; Francis, 1988; Brander, 1988; Blenkarn, 1988; Wolfson, 1988	Wolfson, 1988	(V) Agreement on need for tax revisions, but controversy regarding which changes to make	DCA10.1 6/90

Codes: D=Driving; C=Case; A=Agribusiness; Rev=Reviewer; W=Workshop; I=Interview; Tr=Contradicting comments; FI=Confirming comments

Table 46 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCA11	McQuaig, 1987; Francis, 1986; Kierans & Stewart, 1988			
DCA12	Schumacher, 1973; Robertson, 1983, 1987; Henderson, 1981; RevFiA8			
DCA13	ICE, 1982; Berger, 1983; Turnbull, 1986; Ekins, 1986c; Meeker-Lowry, 1988			
DCA14	I.Gi88.A13; Gips, 1987; Nic, 1989; RevFi5,14	Marquardt, 1989b	(V) Information is often difficult to obtain and expensive to disseminate	DCA14.1 6/90
DCA15	I.Gi88.A16; W.Or88.A3; W.Wi89.A8; Eisenkraft, 1990; Meeker-Lowry, 1988; RevFiA7	Nicholson, 1987; Eisenkraft, 1990	(V) Ethical investment may distract people from supporting truly alternative enterprises	DCA15.1 6/90
		RevTrA42	(V) Ethical investment requires standards and monitoring	DCA15.2 6/90

Codes: D=Driving; C=Case; A=Agribusiness; Rev=Reviewer; W=Workshop; I=Interview; Tr=Contradicting comments; Fi=Confirming comments

Table 46 (cont.)

Driving case code	Confirmation or examples	Contradictions	Revised (V) or Additional (A) case	Code and date
DCA16	I.Gi88.A14; Gips, 1987; Meeker-Lowry, 1988			
DCA17	Nader et al., 1976; Kierans & Stewart, 1988; Francis, 1986; RevFiA17			
DCA18	I.Gi88.A20; Nader et al., 1976; Mintz & Cohen, 1976; Kierans & Stewart, 1988			
DCA19	Nader et al., 1976; Kierans & Stewart, 1988; Francis, 1986; RevFiA5			
DCA20	Speiser, 1986, 1988; Morehouse, 1986; Ekins, 1986b; RevFiA20	Lutz & Lux, 1979	Broadening share ownership proposal may not address issues of democratic management	DCA20.1 6/90

Codes: D=Driving; C=Case; A=Agribusiness; Rev=Reviewer; W=Workshop; I=Interview; Tr=Contradicting comments; Fi=Confirming comments

used to analyze agribusiness activity. This was not a surprising result, as the discipline of agricultural economics has been identified as one of the least likely agricultural disciplines to support an agroecological analysis of the food system (cf. Busch and Lacy, 1983). Many specific comments from these reviewers could not be used because they had no relevance to an agroecological paradigm.

4.2.2 Types, typologies and a general theory

Driving cases from government and research institutional activity areas, and some very preliminary thoughts on agribusiness driving cases (the majority of work on this sector developed after a general theory was formulated), were organized on paper in various arrangements looking for controlled comparisons. Early comparisons focused on using the conceptual tools discussed in Section 3.2 to identify clear sustainable agriculture goals and objectives for each institutional area. These goals and objectives, once identified, would become the agenda for individuals and organizations attempting to promote sustainable agriculture. This analysis drew heavily on Management by Objectives (MBO) thinking (cf. Hersey and Blanchard, 1982). Cases did not, however, fit readily into goal, objective and strategy typologies. As I read more progressive management theory, I concluded that the principal reason for this lack of fit was the failure of MBO thinking to account for ecological realities (cf. Peters and Waterman, 1982; Evans and Russell, 1989). I did retain, however, from this attempt the importance of including some kind of goal-directed typology.

The second major typology attempted revolved around a time scale. Driving cases were sorted according to whether they could be implemented in the short, medium or long term. Feedback from several sources supported my initial idea that incremental changes were possible in the short term as part of a long-term process of profound change. This typology was partly successful in that it identified the ways in which institutional activities can evolve over time. Two weakness were apparent, however: 1) the absence of common purpose in many of the grouped cases; and 2) many of the cases could, in fact, be applied in the short, medium or long term, but it was not possible to determine which of the driving cases would be most efficient in each period.

The decision to attempt an efficiency - substitution - redesign typology was a sudden, intuitive, inspirational one. I was rereading how this typology had been applied to the farm-scale conversion process and suddenly realized it could be applied to changes at an institutional level. It occurred to me that if institutions are to support the transition that is taking place on the farm, then their activities need to change in a manner consistent with agronomic transition.

In setting out to examine whether this typology was appropriate for organizing the cases developed, I first applied it to the three institutional areas in general terms (Table 47). Extrapolating from Hill's (1985a) typology of agronomic transition strategies, I tentatively concluded that efficiency-stage activities at an institutional level should involve minor changes to existing programs, operations and regulations to create a more positive environment for those interested or involved in sustainable agriculture. These kinds of activities would be implemented at lower levels in the structure of an institution or business because

Table 47
General examples of efficiency, substitution and redesign activities (current and potential)

	Process	Content
Efficiency	Modify procedures to speed up decision-making process	Modify existing programs to better meet stated policy, research or business goals
Substitution	Introduce new procedures and accountability models within existing organizational structures	Introduce sustainable agriculture policies, research, or products into current structures and activities
Redesign	Design organizational structures and decision-making procedures to be compatible with ecological "laws" and realities	Adopt sustainable agriculture goals as <u>the</u> goals for the food system, and design and implement programs, research, products and services to meet them

such changes would generally occur in the context of currently acceptable methods of implementation. Generally, costs would not be prohibitive and no complicated analyses would be required. Substitution activities should focus on the replacement of one product, technique or activity for another, or on the addition of a parallel measure with a similar structure but different intent. More levels of the organization would be involved, design and implementation would likely take longer, and explicit approval by senior staff would likely be required. The redesign approach recognizes the existence of ecological laws, and takes them into account in its attempt to mimic ecological processes (Table 4, Section 1.6). Redesign would take the longest time to implement and demand greater changes in the use of human and physical resources than the other approaches. The unique benefit of redesign is that it generates permanent solutions to problems. It would be unlikely, however, to be achieved until institutions have tried efficiency and substitution strategies and found them wanting.

Following this thinking, the driving cases were accordingly arranged (Table 48). The cases fit well into this kind of typology with the exception of some of those in the research domain. In general, solutions in this area are more indirect, long-term and concatenated than those in the other two areas investigated. The differences also reflect the more intangible nature of the scientific process. Although all these sectors are driven by assumptions, the research enterprise is a fundamental expression of our concepts of knowledge. Many of the more tangible activities of policy making and business are based on research outcomes. This difference also explains why certain activities in the research sector appear in different typologies. Retraining programs, for example, are typed as efficiency strategies in the research sector, and as substitution

Table 48
Categorization of driving cases according to an efficiency, substitution, redesign typology

Government	Research	Agribusiness[a]
Efficiency		
DCG1	DCS8.1	*Modifications to legal status of corporation
DCG6	DCS11	*Shareholder control strategies
DCG7	DCS15	
DCG8	DCS21	
DCG13	DCS2	
DCG14		
DCG15		
DCG17		
Substitution		
DCG2	DCS1.1	*Building structures to confront power of large corporations
DCG12	DCS3	*Marketing organic food
DCG16	DCS5	*Ethical investment strategies
DCG18.1	DCS7	*Consumer boycotts
DCG19	DCS9	
DCG20	DCS10	
DCG21	DCS13	
DCG26	DCS14	
	DCS18	
	DCS20	
	DCS23	
	DCS25	
	DCS26	
	DCS27	
Redesign		
DCG3	DCS4	*Localizing the food economy
DCG4	DCS6.1	*New paradigms in economics
DCG5	DCS12	*Redesigning the business bottom line
DCG9	DCS16	
DCG10	DCS17	
DCG11	DCS19	
DCG22	DCS24	
DCG23	DCS28	
DCG24	DCS29.1	
DCG25	DCS30	
	DCS31	
	DCS32	

[a] Preliminary cases developed before any detailed work was undertaken. Cases changed considerably after further data and feedback was collected.

strategies in the government sector. Because information and training is so critical to the research enterprise, retraining strategies better suit the efficiency, than the substitution typology. I feel, however, that this situation does not unduly weaken the typology. It is not clear that any conceptual framework that attempts to be comprehensive can also be totally complete (cf. Lincoln and Guba, 1985)

Using the same method as used to develop cases from themes (seeking relationships between types: causal, functional, symptom and source, means and ends) a general theory emerged: institutional activities to support the transition from conventional to sustainable agriculture can be analyzed by, and implemented, according to an efficiency - substitution - redesign typology. Such a general theory meets Diesing (1972)'s criteria for general theory: holistic (the theory covers the full range of possible institutional activities); concatenated rather than hierarchical (each type is distinct and yet connected to the others); close to ordinary experience (it organizes the real activities of real institutions); and dialectically related (in a conversion context, action in any of these three areas draws attention to existing or potential activities in the other two). These ideas are more fully developed in the discussion.

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; Forbès, 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[13] (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

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13. 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).

Table 49

Canadian policies and programs implicated as impediments to diversification of farming systems

Program, policy, or act	Cited in
Canada Wheat Board quotas	Senate of Canada (1984); Nowland (1987); Veeman (1987)
Feed Freight Assistance	Same as above
Ontario Drainage Act and municipal taxation	Conservation Council of Ont. (CCO) (1986); Gilson (1987)
Western Grain Transportation Act	Gilson (1987); Veeman (1987); Carmichael & Macmillan (1988) Economic Council of Canada (1988)
Western Grain Stabilization Act	Pidgeon (1984); Gilson (1987) Economic Council of Canada (1988)
Agricultural Stabilization Board	Bond et al. (1986)
Deficiency payment programs based on acres seeded	Carmichael & Macmillan (1988)
Special Canadian Grains Program	Economic Council of Canada (1988)
Federal Fertilizer Act	Greenprint for Canada (1989)
Pesticide registration process	Greenprint for Canada (1989)
Crop insurance programs	Pidgeon (1984); CCO (1986) Gilson (1987); Veeman (1987)
Ontario sales tax exemption for synthetically compounded fertilizers and pesticides	----
Major crops and livestock production subsidies	Bond et al. (1986); Fleming (1987); MacRae (1987); Postel (1987)

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[14].

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

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14. 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.

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

Table 50
Some specific Canadian governmental and para-governmental regulations and operating practices implicated in restraining the development of organic farming

Agency / system	Problem implicated
Marketing Boards / Agencies	
Wheat Board (Ontario) Potato (Manitoba) Dairy (federal) Soybean (Ontario)	No organic food channels; limited # of wholesalers licensed by board who also buy organic; organic growers not represented on standards committees; organic growers pay for irrelevant services.
Grading	
Egg (Ontario) Fruit (federal)	No organic food marketing channels. Encourages use of pesticides to achieve cosmetic perfection, which receives top grade
Health	
Some livestock health regulations, such as those applying to black leg, and warbles (Alberta), and Marek's disease treatments (Ontario)	May contravene certification standards for organic food
Dairy sanitation regulations, specifying use of chlorine/iodine	May contravene certification standards for organic food
Labelling	
Regulations re: labels on packaged imported goods at the retail level	Small volume relative to conventional channels, for which regulations were developed, creates relatively higher costs and labour needs
Credit	
Office du Credit Agriçole loan approval systems (Québec)	May require evidence of chemical use to approve loan. May not recognize existence of premium prices for organic food so dispute accounts

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[15], 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.

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15. 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).

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[16]

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

16. 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.

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). An ad hoc 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 stengthened (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[17].

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

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17. 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).

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 colours 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 regualtions 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)[18].

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 assis-

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18. The recent FCC restructuring suggests that they are now less inter-

tance. 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[19]. 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[20] (British Organic Farmers and Organic Growers Association, 1988). Some analysts propose

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ested in being an instrument of government policy (Bertin, 1989b).19. 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.

20. 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).

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[21]. 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 penalities 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[22], 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

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

22. 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.

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 suggest 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)[23]. 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 agrichemicals amd 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

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23. 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).

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 diversifed cropping systems as compensation for the loss or restriction of agrichemical 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

Table 51
Goals for a sustainable food system and their relationship to ecological principles ("laws")
(Adapted from Cornucopia Project, 1981; Hill, 1982; Dahlberg, 1985)

PARAMOUNT GOALS: Nourishment
Human development and fulfillment
Environmental sustainability

SUB-GOALS: The food system:

__Consumption__

A. **Adequacy:** should give every person access to sufficient food in quantity, quality and degree of choice, to achieve optimal physical and mental health. (1,3)*
B. **Appropriateness:** should be matched in production, consumption, recycling, thermodynamics, and technology to both the limits and needs of its region and locality. (2,3,6)

__Security__

C. **Dependability:** should provide every person with a reliable food supply - free from social, political, economic and environmental disruption. (4,6)
D. **Sustainability:** should be culturally, environmentally, economically, and technologically sustainable with respect to production and all other aspects of the food system, including resource inputs, cultivation techniques, processing and distribution. (all)
E. **Safety:** should minimize danger to workers, consumers, and the environment. (1,3)
F. **Efficiency:** should practice resource efficiency by incurring minimal resource costs (energy, water, soil resources, genetic resources, forests, fisheries and other wildlife). (1,6)

__Equity__

G. **Wealth:** should generate sufficient income to food producers to provide a quality of life (measured by a variety of indicators) equivalent to that of other sectors of the economy, to maintain vigorous rural communities and enable farmers to fulfill their land stewardship responsibilities. (4,6)
H. **Flexibility:** should be open to growth, evolution, creativity, and experimentation to deal with climatic, economic and political stresses and variability. (4,5,6)
I. **Participation:** has its organization, decision-making process and course towards the future determined by all sectors of the population that wish to be involved. (4,6)
J. **Human development and fulfillment:** must provide opportunities for creative and fulfilling paid and unpaid work, social interaction, psychosocial evolution and social justice. (4)
K. **Support:** should interact with the food systems of other nations in such a way that they are able to achieve similar goals, including a sustainable food system. (1,6)

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* Goals are based on the principal ecological "laws" presented in Table 4.

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 insectivourous 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[24]. 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 in-

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

dustry 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[25]

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

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25. 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).

"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. Various 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)[26]. 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).

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26. 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 negotations. 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.

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 low-fat 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 aroung 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, confectionary, 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 agrichemicals 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[27].

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 initatives 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

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27. 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.

"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 occuring 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

Table 52
Example of current vs. redesigned grading criteria for melons (Canada #1)

Current[a]	Possible redesign
* Fairly clean, well formed, mature, well netted for the variety, sound, of one variety and do not, when in a package, vary more than 1.5 in. in diameter	* Produced in accordance with standards of a recognized sustainable agriculture production system
* Free from insects, insect larva, insect injury, disease, decay, sunscald, moisture injury, cracks or hail marks	* Harvested within 3 days of optimal harvest date and made available to consumers within 3 days of harvest
* Free from any injury or defect or combination thereof, other than an injury or defect referred to in paragraph (b), that affects the appearance, edibility or shipping quality of the melons	* Free from any injury, defect, insect or disease damage that affects the keeping and nutritional qualities of the melons

[a] Reg. 332, Farm Products, Grades and Sales Act.

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[28]. 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

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28. 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).

Figure 10

Hypothetical example of a label for an instant baby food cereal[a]

		Rating
Contents: Whole wheat		
Production:	Certified organic (biological method)	8[b]
Processing:	Regular milling: excessive heat	5[c]
	No supplements	10[c]
	Milling by-products recycled	7[d]
Product distribution:	Local	8[e]
Food analysis[f]:	Medium fibre	6
	No sodium	10
	No sugar	10
	Low fat	8
	Medium trace minerals	6
	Medium important vitamins	6
Social justice[g]:	Safe working conditions	8
	Wage rate is below industry average	5
	Preferential purchase of raw materials from the region	8
	Minimal pollution	8
	No donations made to charities	0

[a] This figure is presented for illustrative purposes only. Clearly an enormous amount of work would have to be invested in collecting relevant information, designing appropriate educational materials, indices, labels, administrative procedures and funding strategies. We also recognize the difficulties of developing general numerical scales for such complex subjects.

[b] Using a scale as per Figure 1.

[c] Based on Grimme et al. (1986) classification of processing methods and their desirability for the human diet.

[d] Based on a scale - 10 No waste products; 8 By-products reused in same process; 6 By-products recycled in another process; 4 By-products partly recycled; 2 By-products incinerated; 0 By-products are an untreated pollutant (cf. Jackson and Weller, 1983).

[e] Based on scale: 10 Direct; 8 Local; 6 Regional; 4 National; 2 International (cf. Cornucopia Project, 1984; Harnapp, 1988 regarding the economic benefits of different distribution systems).

[f] Index of compliance with nutritional content of product from ideal production, processing and distribution conditions. These ideals, at a minimum, could be produced from existing nutrient content data.

[g] Cf. Will et al., 1988.

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 Prairie 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[29] 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

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

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 agricultural 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. Various 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 CLTs 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 and provincial governments 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 spinoffs from sustainable agriculture have yet to be fully explored; however, the Advisory Panel on Food Security, Agriculture, Forestry and the Environment (1987) has 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 is 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 few 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). Morgan (1989a:55-56) has stated that ". . . 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

Table 53
Some implications of ecological principles ("laws") (Table 4) for organizational design of government departments

Design	Responds to "Law"
1. Organization has clear long-term purpose, well-understood by all employees (Peters & Waterman, 1982; Beaubien, 1986). The evolution of the organization is clear and consciously planned (Plumptre, 1988).	1
2. Shift decision-making power to people closest to the environment (staff level, middle managers) (Peters & Waterman, 1982; Johnson & Frohman, 1989).	2
3. Develop more lateral, as opposed to vertical, lines of communication (Johnson & Frohman, 1989) (meetings across unit lines, outside unit peers involved in staff evaluation).	2
4. Make decisions before all the information is in, based on both technical and qualitative data (Veeman & Veeman, 1976; Ulrich & Wiersema, 1989), and on identified key variables that indicate the functioning of the whole (Walters & Holling, 1984). Monitoring key variables is the key to management (Peters & Waterman, 1982).	2,5
5. Spread risk by investing in more than one approach to solving a problem (Plumptre, 1988; Ulrich & Wiersema, 1989). Strive for redundancy of function, not redundancy of parts (Peters & Waterman, 1982; Morley, 1989). Disaggregate to create many operating units, each with low cost of failure (Walters & Holling, 1984).	4
6. Introduce evaluation systems in which employees share the organizational risks and benefits (Ulrich & Wiersema, 1989).	1
7. Design management standards around the needs of each unit (Osbaldeston, 1988). Managers focus on empowering employees to make them more effective contributors to the goals of the unit (Evans & Russell, 1989).	4,6
8. Hire generalists of different backgrounds who can work in different teams. Teams work on different tasks, depending on needs (Morgan, 1989a).	2,4,5
9. Establish minimum organizational specifications and controls that conserve organizational resources and allow for spontaneous internal reorganization to adapt to changing conditions (Peters & Waterman, 1982; Morgan, 1989a).	5,6
10. Store up outputs in times of surplus for release during periods of deficiency (already done in cases of some physical goods) (Walters & Holling, 1984).	3,4,6
11. Establish open-ended networks of interdependent allies, inside and outside the organization, to build collaborative solution finding (Solway, 1988; Morgan, 1989a).	5,6

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).

Table 54
Some potential threshold indicators in agriculture based on an agroecological paradigm

Threshold indicator	Phenomenon
1. Development of pest resistance to a pesticide	Aggravated pest problem (cf. Dover, 1985).
2. Pest outbreaks and development of secondary pests	Inappropriate design of agroecosystem (often excess N or excèssive use of pesticides) (cf. Chaboussou, 1982; Patriquin et al., 1986).
3. Soil degradation	Inappropriate design of agroecosystem (often unsuitable crop rotation and tillage) (cf. Reganold, 1988)
4. Elevated levels of rural family breakdown	Financial stress and degradation of rural community (cf. Walker and Walker, 1988; Small et al., 1989).
5. Increasing need for government subsidies to support farm income	Biological capital of system is overdrawn (cf. Henderson, 1981; Cox, 1984).
6. Consumer fear (real or perceived)	Unsuitability of product or process (e.g., Alar, food irradiation, BST, Texas response to EEC beef hormone dispute [cf. Presnal, 1989]).

Table 55
An alternative problem-solving framework for institutions
(adapted from Hill, 1986b)

Old	New
* symptoms, "cure"	* causes, prevention
* reductionist	* holistic
* eliminate "enemies"	* respond to indicators
* narrow focus (neglects side effects, and health and environmental costs)	* broad focus (subcellular to all life on globe, all costs internalized)
* instant, short term	* long term (future generations)
* single, simple (magic bullet)	* multi-faceted, complex
* temporary solutions	* permanent solutions
* unexpected disbenefits	* unexpected benefits
* high power (risk of errors/accidents)	* low power (minimal risk)
* direct "attack"	* indirect approaches (catalytic, multiplier, synergistic effects)
* imported	* local solutions and materials
* products	* processes, services
* physico-chemical (often synthetic)	* bio-ecological
* technology intensive	* knowledge / skill and appropriate technology intensive
* centralized	* decentralized
* values secondary (or latent)	* compatible with higher values
* expert	* individual / community responsible
* dependent	* self-maintaining / regulating
* inflexible	* flexible
* ignores freedom of choice	* respects freedom of choice
* disempowering	* empowering

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.

5.2 Research institutions

This section addresses four of the six aspects of transition identified in Table 47. Applied to research institutions, the process category includes the mechanisms by which science is taught, organized, funded and rewarded. The content category includes the research questions asked and the methodologies used to address these questions.

The need to change the subject (or content) of research, and the associated new sustainable agriculture research agenda, have been well identified by numerous authors (Madden and Tischbein, 1979; USDA, 1980 and 1981; Harwood and Madden, 1982; Alternative Farming Task Force, 1983; Hill, 1984a; University of California Committee on the Sustainability of California Agriculture, 1986; Hendrix, 1987; Francis and Sahs, 1988; Otis and Fournier, 1989). Although not organized according to efficiency, substitution, redesign categories, these studies as a group cover much of the research agenda identified by that framework (cf. Hill, 1985a). At the efficiency stage this would include conventional plot and laboratory studies examining topics such as conservation tillage or chemical banding. Substitution strategies would involve investigating a clearly important sustainable agriculture topic, such as ecological control of quackgrass, but still using predominantly reductionist, positivist approaches. These kinds of topics are well covered in the research agenda studies listed above. The area that has received less attention, and will be addressed here, is the redesign stage. At this level, the most profound research questions facing sustainable agriculture are examined using a diverse mix of research paradigms, including non-reductionist, non-positivist ones.

Regarding the process of agricultural science, efficiency, substitution and redesign strategies will be presented, and the key problems with the process of research identified in each section. Many of these problems (and their solutions) are not specific to agricultural science and have been extensively reviewed in the literature on the history, philosophy, psychology and sociology of science (cf. Maslow, 1966; Kuhn, 1970; Leiss, 1972; Mahoney, 1976; Berman, 1981; Albury and Schwartz, 1982; Levins and Lewontin, 1985; Lincoln and Guba, 1985; Martin et al., 1986; Savan, 1988). The emphasis here will be, however, on the implications of these general problems for agricultural research institutions.

5.2.1 Broadening the world view of agricultural scientists

Society's preferred view is that the scientist is objective, unswayed by the surrounding turmoil, and free to choose projects that are interesting and, at the same time, of benefit to society (Mahoney, 1976; Hadwiger, 1982). Unfortunately, this is usually far from reality.

5.2.1.1 Objectivity, emotions and values

Historically, science has been thought to be valuable because it seemed to lead down the objective path to truth or knowledge. Scientifically proven facts were considered units of knowledge that described phenomena and made the world understandable, but recent thinking indicates that knowledge is what we experience and involves facts plus the socio-economic, cultural, political, and emotional context in which we perceive them (Maslow, 1966; Davenport, 1982; Busch and Lacy, 1983; Miller, 1985a). Because scientists have confused facts with knowledge, they have believed tnat fact could be separated from its context (value or experience) (Mahoney, 1976; Pais, 1982; Miller, 1984; Shephard, 1985). This, in their eyes, has made facts objective, but in nature objectivity can never actually exist because everything takes place within a context (Bahm, 1979; Skolimowski, 1981; Capra, 1982). Paradoxically, although scientists believe that it is important and possible to separate fact from context, studies have shown that most of them find it extremely difficult to do so because they are unable to describe their own context for interpreting facts (Mahoney, 1976; Miller, 1985a). Conventional science has not adequately measured knowledge or experience because the intuitive (that which is experienced) has been separated from that which is scientifically described. Phenomena are more completely described by examining their relationships with other phenomena.

Many scientists attempt to avoid emotion, believing they must be objective at all times (Mahoney, 1976; Miller, 1983b; Savan, 1988). In reality, scientists are potentially as emotional as the average individual, but most have become quite skilled at denying that their personal feelings have an impact on their scientific work (Kubie, 1956; Mahoney, 1979; Hill, 1986b). Emotions may, however, be an essential part of the investigative and creative process (cf. Reason and Rowan, 1981a; De Mey, 1982; Lincoln and Guba, 1985), or may get in the way of doing good science (Kubie, 1956; Maslow, 1966; Mahoney, 1986; Hill, 1987; Appendix 1). Many of these emotional traumas have perpetuated a male-dominated science that has limited participation by women and the expression of a feminist perspective on the relationship between humans and their environment (Hallen, 1988).

One of the main emotional obstacles blocking conventional scientific support for sustainable agriculture is fear, and in most cases unacknowledged fear. Scientists are part of the prevailing western culture that for many years has equated control of nature with social progress (Leiss, 1972). According to this position, the failure to control nature lays the foundation for social decay. For many, sustainable agriculture appears, from their limited analysis, to be a mechanism for letting nature run wild or, at least, it represents a return to an earlier, less developed or primitive stage. In their view, to practice sustainable agriculture is to let nature take control (Coleman, 1982).

5.2.1.2 The social, political and economic context for agricultural research

Most agricultural scientists have conservative social and political values (Hadwiger, 1982). They have had a long history in Europe and in North America of sharing, often naively or subconsciously, the interests of the dominant industrialist class in society, and of practicing science to solve problems that this class has defined (Gouvernement du Québec, 1979; Vandermeer, 1981; Albury and Schwartz, 1982; Hadwiger, 1982; Danbom, 1986). Agricultural scientists, usually idealists committed to making constructive changes, have generally shared the reductionist economic definition of efficiency in which environmental and other negative impacts are considered largely external to analyses (Friedland and Kappel, 1979;

Heffernan, 1986; Madden, 1986a). They have had a negative view of agricultural labour and an associated commitment to mechanization (Rodefield, 1978; Vandermeer, 1981; Busch and Lacy, 1983), and have preferred to focus primarily on the production of marketable products rather than management of agricultural systems. Public health scientists, who are often involved in evaluating the health effects of agricultural technologies and practices, generally share conservative industrial and government perspectives on public health threats (Paigen, 1982; Coye, 1986).

Moreover, industrialist values amongst agricultural scientists have contributed to the evolution of large-scale, capital-intensive production units, the decline of farm numbers, and the erosion of rural communities (Hightower, 1972; Rodefield et al., 1978; Friedland and Kappel, 1979; Troughton, 1985; Heffernan, 1986). Scientists have done this by allying themselves, consciously or subconsciously, with the clients that can best make use of the products and technologies that they produce, namely large farming operations and agribusiness. These are the groups that have had the financial, labour, and land resources to help scientists to develop and then to take advantage of the new technologies. In turn, early adoption has improved their competitive position and helped to drive farmers with small operations out of business (Friedland and Kappel, 1979; Hadwiger, 1982; Ruttan, 1982; Busch and Lacy, 1983; Heffernan, 1986), and in the process reduced the vibrancy of rural communities (Fujimoto, 1977; Vogeler, 1981; McClatchy and Abrahamse, 1982; Heffernan, 1986). Vogeler (1981) estimated that no more than 35% of USA farmers have benefited from research performed in the publicly funded research sector.

Scientists' outlook is perpetuated by narrow scientific training (Kubie, 1956; Kuhn, 1970; Hadwiger, 1982; Miller, 1984). Even those scientists who deal with environmental issues usually study only their purely technical aspects and receive little training in examining philosophical and ethical questions (Miller, 1982). The end result is a highly specialized (and often idealistic) scientist who views all problems through a narrow window (Danbom, 1986; Hill, 1986b), has difficulty synthesizing information (Hill, 1978; de Rosnay, 1979), and has trouble conceptualizing (Miller, 1983a). There is tremendous pressure in graduate school to conform to the prevailing view, and agricultural schools suffer more than others because many are geographically and administratively isolated from other faculties within the university system (Mayer and Mayer, 1974; Friedland and Kappel, 1979; Hadwiger, 1982). Kuhn (1970:166) states that "...scientific training is not well designed to produce the man (sic) who will easily discover a fresh approach."

Once part of the profession, the North American agricultural scientist is not likely to come across many who will express a distinctly different view, because a majority of his peers will be of similar gender and race, and have similar backgrounds and training (Center for Rural Affairs, 1982; Hadwiger, 1982; Busch and Lacy, 1983). Institutions, by means of their disciplinary divisions, usually reinforce the narrow view (Dundon, 1982). These conditions contribute to an elitism that generally characterizes agricultural science: the belief that only those who are part of the profession are sufficiently knowledgeable to conduct agricultural experiments and draw conclusions about the results (Todd, 1978; Miller, 1982; Busch and Lacy, 1983; Bennett, 1986). In this environment many scientists are reluctant to accept new ideas, knowingly or unknowingly (Kuhn, 1970; Truzzi, 1979; Buttel, 1980).

There are many implications for sustainable agriculture. First, agricultural scientists with modern industrialist and technocratic values will tend to see solutions in terms of discrete technologies that can be applied universally to specific, economically valuable commodities. Many behave as if it is their role to develop solutions that the market place can disseminate (Hadwiger, 1982; Heffernan, 1986). This is particularly the case in agricultural biotechnology research (Doyle, 1985; Buttel, 1986a; Office of Technology Assessment, 1986), but has also long been a feature of the relationship between agriculture and the food industry (Hall, 1974; Vogeler, 1981; Hadwiger, 1982; Danbom, 1986). Most of the problems faced by those practicing sustainable agriculture cannot be solved with commercial products or discrete technologies, but rather require the examination of the design and management of the production systems themselves (Hill, 1985a; Buttel et al., 1986; Patriquin et al., 1986; Altieri, 1987). University and government agricultural scientists have failed to develop a "design research paradigm" that could be used to investigate potential design and management solutions, even though some other disciplines, faced with similar problems, have moved in this direction (Koenig, 1985).

5.2.1.3 Solutions

Sustainable agriculture, in contrast, is admittedly value laden. It expresses deep commitment to the land (Leopold, 1949; Jackson et al., 1984), to conserver lifestyles (Buttel, 1980; Parr et al., 1983), to the rejuvenation of rural communities and culture (Berry, 1977), and to economic systems that place value on human fulfilment and the environment and that discourage an emphasis on mere commodity exchange in the market place (Schumacher, 1973; Ekins, 1986a). Practitioners accept that farming takes place within a socio-economic and political framework, and that scientific investigations into problems must take these realities into account. The belief of conventional scientists that it is possible to be socio-politically detached and ignore the consequences of one's work (Hightower, 1972; Hadwiger, 1982; Busch and Lacy, 1983; Miller, 1985a) is not compatible with sustainable approaches.

5.2.1.3.1 Retraining: an efficiency strategy

Efficiency strategies involve making changes to the way currently employed resources are used and retraining involves changing the deployment of human resources. Retraining of agricultural professionals by using short courses, seminar series and workshops could be a successful part of addressing the kinds of problems discussed above. Universities could design such programs for their own staff and for those of government agencies. Most institutions already have some mechanism for providing retraining on other topics. The Québec government has undertaken a process of outlining professional training needs by holding meetings with the universities, colleges and farmers to discuss a province-wide plan to upgrade skills in agroecology (see also the discussion in Section 5.1.2.1.1)

5.2.1.3.2 Offering sustainable agriculture programs: a substitution approach

Training people in sustainable agriculture is a key strategy for its implementation. Educators and disciplinary associations could develop sustainable agriculture programs that permit graduating agricultural scientists to:

1. understand the historical evolution of science and particularly their own science (Kuhn, 1970; Bahm, 1979);

2. list the stages of scientific problem formulation, experimental design, data collection and analysis, and the often latent influences on each stage (Miller, 1982; Savan, 1988);

3. conceptualize (Miller, 1983a);

4. recognize and integrate the technical, psychosocial and moral aspects of a problem (de Rosnay, 1979; Miller, 1984);

5. identify the ethical issues underlying any agricultural research and decision making (Dundon, 1982; Shepherd, 1985; Freudenburger, 1986);

6. engage in constructive intellectual and interpersonal conflict resolution (Miller, 1984);

7. list principles of logic (Mahoney, 1976);

8. demonstrate how science develops confident assertions rather than truth (Leiss, 1972; Mahoney, 1976; Bahm, 1979);

9. recognize the limitations of conventional and alternative approaches to agricultural science and list the philosophical and opera-

tional principles of new paradigms that can be used (Reason and Rowan, 1981a);

10. describe the principles of ecology and their application to agriculture (Lowe and Worboys, 1980; Hadwiger, 1982; Conway, 1986; Hart, 1986);

11. list the principles of economic systems that value ecological imperatives (Lynam et al., 1986; Hill, 1987; Wagstaff, 1987);

12. describe the root causes of hunger, poverty and oppression. Dundon (1986), in his study of innovation in agricultural science, has found that innovative agricultural scientists have had some exposure to, or strongly expressed concern for, the poor and disadvantaged (whether in the developing or developed world).

13. provide essential information on the area of study. For example, if the principal area of study is soil science, students should be able to answer the questions outlined in Table 56.

These kinds of programs in support of sustainable agriculture are no longer a rarity. More than two dozen universities and colleges in the USA now offer programs (Wisconsin Rural Development Center, 1986; Gates, 1990). Courses and programs are being offered in Europe (Kølster, 1987) and McGill University now offers a minor in ecological agriculture. Governments could assist this process by establishing chairs in sustainable agriculture at universities. The European Parliament is studying the feasability of doing this with its member states (Bourguignon, 1989).

Table 56

Examples of questions students should be able to answer in a sustainable agriculture soils program (adapted from Hill, unpublished)

* How to measure soil "health" (fertility plus) in the field & laboratory: including use of bioassays such as weeds & soil fauna as indicators of nutrients & structure.
* How to describe soil genesis as a process of interrelated & interdependent ecological, biochemical, geological & sociological factors.
* How to identify soils in the field & evaluate their agricultural potential with & without access to laboratory facilities.
* How to select a unique appropriate management program for a particular soil (equipment, its use, timing of operations, etc.).
* What the functions of the different groups of organisms are in soil & how soil "works" (cycles, processes, etc.).
* How various soil management practices affect the various groups/species of soil organisms & how these practices can be used to support beneficial groups.
* Which soil & water conservation practices are indicated for a particular soil/location.
* Which cropping patterns to prescribe for a particular soil/location (to ensure sustainability).
* Knowledge of properties of main soil improving crops, including many so-called weeds (legumes plus).
* Knowledge of properties of main soil implements & techniques for irrigation & drainage, & effects of their use on energy budgets, erosion, the O.M. & N pools, envrionmental impact, crop quality, susceptability to pests.
* Design of optimal systems for collection, processing, composting, handling, & applying the various types of organic wastes to maximize long-term benefits to soil & the environment as a whole.
* How to calculate permissible levels of crop residue removal for use as biomass.
* What are the best ways to use rock fertilizers?
* How climate influences soil properties & processes.
* How the siting of buildings, fences & roads affects soil.
* What are the best ways to use seaweed sprays & amendments & how can other sources of plant hormones be incorporated into soil management programs.
* What are the relationships between soil conditions, crop production & quality, & livestock & human health?
* What are the long-term effects of the various types of pesticides, herbicides & soluble fertilizers on different types of soils/locations?
* How to develop soil management programs for polyculture agroecosystems, e.g., agroforestry systems with & without livestock & fish culture.
* How to advise farmers who wish to set up on-going experiments relating to soil management.
* How to explain how the soil works to farmers, consumers, school children & politicians.
* Knowledge of how socio-cultural, economic & political factors affect soil; including the various laws, regulations, codes, tax incentives, & subsidies, & factors that determine land cost & how these can be adjusted to promote a sustainable agriculture & solve soil problems.
* Who to go to for expert help & to answer these questions if given access to an agricultural library, desk computer terminal & telephone.

5.2.1.3.3 Redesigning the pedagogy of the agricultural curriculum

The following pedagogical philosophy and techniques can be used (adapted from Romey, 1976; de Rosnay, 1979; Bawden et al., 1984; Hill and MacRae, 1988):

1. The instructor's task is to create a supportive environment to nurture motivation and self-concepts and to avoid getting in the way of natural development. The instuctor can also help students to recognize positive and negative influences of past personal experiences on the way in which the student perceives the food and agriculture system (Hill, 1987). This kind of counselling could also be a part of the institutional workplace.

2. A systemic, rather than a linear or sequential, approach must be used in which the instructor returns to the subject several times but at different levels.

3. Rather than just providing precise definitions, a new concept should be studied from different angles and in different contexts.

4. The dynamics and interdependence of biological systems must be stressed.

5. Themes that can be vertically integrated should be used to develop ideas. In agriculture, the theme of food quality can use ideas from agricultural disciplines such as soil science, plant science, animal science, and human nutrition.

6. Facts are always provided in a broad context.

7. Consider the student a co-instructor in any course. Course time can be set aside to allow students to teach each other (seminars, dis-

plays, constructive discussion, circulation of term papers, team projects).

8. Instructors should encourage students to define their personal goals and act as allies to help students meet these goals. Students design their own programs and evaluation systems with the aid of instructors.

9. Assignments can be designed to approximate real-world experiences including role playing, writing articles for the popular media, conducting surveys, event organizing, and political action projects.

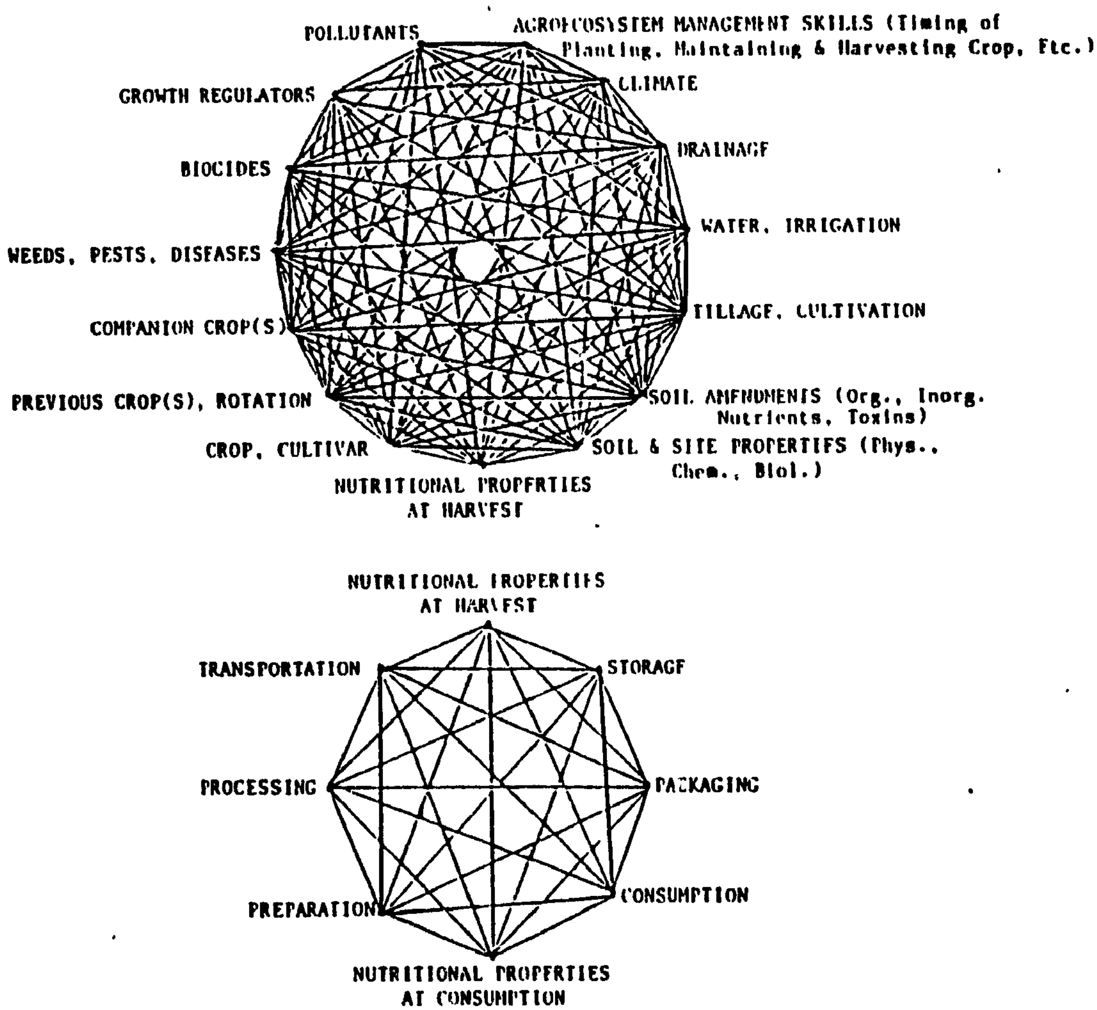
10. Students spend part of their program working directly in the agricultural milieu (farms, food businesses, government bureaus).

5.2.2 Reducing the dominance of reductionist, positivist approaches

Western science has a long tradition of dividing scientific problems into discrete, manageable pieces, a process commonly referred to as reductionism (Kuhn, 1970: Bahm, 1979; Capra, 1982). Reductionist thinking remains central to much of agricultural science today (Hall, 1974; Dundon, 1982; Miller, 1985a; Madden, 1986a) and many of our current agricultural and environmental problems can be traced to it (Miller, 1982; Hodges and Schofield, 1983; Levins and Lewontin, 1985). Holding constant or ignoring all but the few factors under examination means that agricultural research is removed from the reality of socio-economic and ecological systems in which all factors, known and unknown, measurable or not, are constantly interacting (Figure 11). Scientists commonly argue that it is possible to integrate the distinct pieces that result from reductionist science into a whole or system, but with respect to natural systems this has proven

Figure 11
Examples of complex interrelationships in agriculture: major on-site and post farm-gate factors affecting food quality
(Hill, 1980)

1. HOLISTIC VIEW.



2. COMMON CONVENTIONAL VIEW

largely unsuccessful, partly because some of the relationships between the relevant factors are ignored or remain to be discovered (Hanway, 1978; Busch and Lacy, 1983; Miller, 1985a; Suzuki, 1987). Because of this, it is difficult to apply much of the work that has used the reductionist approach to sustainable systems.

A further obstacle associated with reductionist thinking is the belief in universal technologies, and the associated concept of inductive generalization. The appeal of this approach is that it allows one to study a sample as if it were representative of an entire class (Maslow, 1966). This has resulted in the development and commercialization of such universally applied products as antibiotics, pesticides, and fertilizers. To support universality, elaborate assumptions have been developed to explain how diverse biological systems in different locations can be regarded as the same (Dundon, 1982; Bennett, 1986). Sustainable approaches, on the other hand, stress uniqueness of time and place and of working with local natural resources and processes.

It is not possible to analyze complex biological systems by examining a few variables and then successfully apply the results over a broad area (MacRae and Mehuys, 1985; Miller, 1985a; Bennett, 1986). Nor is it possible to always find direct, single cause-and-effect relationships between factors, a search that is central to reductionist thinking and the desire to control or manipulate nature (Hall, 1974; Henderson, 1981; Davenport, 1982; Levins and Lewontin, 1985). In the reductionist view, nature, or any reality, is simple and must 'make sense' (Maslow, 1966; Mahoney, 1976), but complex biological systems do not always make sense, especially at our present stage of understanding. Moreover, agricultural scientists have tended to avoid complex biological questions, including those raised by sustainable agriculturalists, and have focused instead on researching specific problems related to specific food commodities (Hall, 1974; Busch and Lacy, 1983). The most common manifestation of this attitude is found in the use of laboratory and small plot studies to investigate complex systems. Busch (1984) considers that this process of inquiry is inherently flawed because biological phenomena are removed from the environment in which they occur, are examined (often under highly controlled laboratory conditions) and then tested in a simulated version of their environment (the field trials) that, in reality, is more like the laboratory than the real world. In this process experimental results can rarely be repeated by the people that the experiment was intended to help. Insufficient technical and financial supports have been provided to scientists in research institutions, such as Agriculture Canada, to encourage on-farm research strategies to counter this kind of problem (Wanczycki, 1984).

Most scientists also believe that quantifiable facts are essential to rational evaluation of information and accurate descriptions of reality (Mahoney, 1976; Miller, 1985a), the positivist paradigm. Unfortunately, the quantification that conventional scientists desire is not always attainable and is not always essential for achieving the required understanding of biological systems. Kuhn (1970) argues that this belief in quantification flows unavoidably from the evolution of traditional scientific paradigms. Once a paradigm has been established, the scientific community that adheres to it sets out to prove the validity of its application to an ever widening range of increasingly refined and narrowly defined problems. Examples of such a paradigm in agriculture include the development and use of herbicides such as 2,4-D in weed science, and of soluble fertilizers in agronomy and soil science (Dundon, 1982), and the determination of food value by measuring certain chemical components in nutritional sciences (Hall, 1974).

To do this effectively, that is, to make the paradigm fit a diverse range of problems, requires increasing quantification and specialized equipment (Kuhn, 1970). In this process, variables that are quantifiable tend to be overemphasized (Miller, 1985a). Scientists and funding bodies are often convinced by studies with the most quantified data, even if qualitative or conceptual factors in the analysis are weaker than in other studies (Kuhn, 1970; Mahoney, 1976).

The fascination with numerical modelling is a common expression of this process, particularly with regard to complex biological systems. Although such models may be internally logical and scientific, they are often unrealistic (Hillel, 1987) and conceptually weak (Miller, 1985a). A further aspect of the desire to quantify is the use of statistics, which is seen as necessary to validate experiments. Unfortunately, because most conventional scientists frequently miss the unexpected (due to the narrow range of results anticipated) (Kuhn, 1970; Mahoney, 1976), statistics can effectively act as an information-limiting device (Diesing, 1972; Truzzi, 1979; Paigen, 1982; Schrecker, 1984; Lincoln and Guba, 1985; Miller, 1985a). Grierson (1980) points out that our current statistical methods require clearly defined variables and parameters, yet few of the difficult problems in his field (horticulture) have been successfully investigated to the point where these variables and parameters can even be identified. He also concluded that many investigations in biological sciences are not suited to statistically designed experiments, and the pressure to use statistics discourages scientists from tackling some of these studies.

Mahoney (1976) reached similar conclusions in his research on the social sciences.

5.2.2.1 Research impact assessments: an efficiency strategy

To address these kinds of problems, a number of investigators have suggested that research impact assessments be performed during the course of project formulation and implementation (Madden, 1978; Friedland and Kappel, 1979; Conway, 1986). Such an assessment involves examining the possible socio-economic and environmental implications of a range of possible research outcomes associated with a given project. These kinds of assessments have rarely been performed and their methodology, as a result, is not particularly strong. Most assessments that have been done have been compromised by the biases of the investigators, by being overly bureaucratic, and by incomplete examination of the issues (Friedland and Kappel, 1979). Busch (1984) cautions that impact assessments are limited because they are often applied too late to change the experiment or the technology. In his opinion, the scientist, having invested considerable energy in developing a project to the point where assessment occurs, is likely to be very resistant to such an assessment. But given the generally unanticipated negative impacts of agricultural research, it is clearly in the interest of research administrators to establish some kind of impact assessment process and provide support for it. There may be a legal imperative. The University of California was successfully sued for its involvement in mechanization research that left many farmworkers out of work, and was required to submit a plan to "ensure that funds authorized under the Hatch Act, are expended in a manner ... with primary consideration for the small family farmer." (California Agrarian Action Project *vs* Regents of the University of California, 1987). The case was appealed by the University, and the decision recently overturned. A bill presently before the USA Congress would require that social impacts be performed as part of the funding application process for studies funded by the USDA (Scheid, 1990).

5.2.2.2 Some substitution strategies

In the past few years, US and European research institutions have established research facilities to investigate sustainable agriculture (cf. Wisconsin Rural Development Center, 1986; Zadoks, 1989). This strategy, in addition to generating data, provides a high profile, both internally and externally, for sustainable agriculture inititatives. Canadian institutions have been slow to follow suit, but initiatives are underway at Macdonald College, Laval University and the University of Guelph.

Often in association with the development of these facilities, scientists become more interested in on-farm research. Farmers, and other individuals who are directly involved in the food and agriculture system, are increasingly recognized as having much to contribute to our understanding of ecological processes in agriculture (Altieri, 1983; Levins and Lewontin, 1985). Some investigators even feel that most innovation in sustainable agriculture originates with the farmer (Brusko et al., 1985; Woodward, 1985). The potential value of lay science is reflected in the Office of Technology Assessment (1985) conclusion that most innovative research is not taking place in the institutions normally associated with research activity.

Although farmers have always experimented (cf. Center for Rural Affairs, 1980), the organization of on-farm research has been changing in recent years in response to growing institutional recognition of the value of such research efforts. Farmer associations are being created specifically to perform research (Krome, 1988; Exner, 1990), and manuals for lay scientists have been developed (Bruško et al, 1985; Thompson and Thompson, 1985). Scientists are consulting directly with producers on appropriate research programs and projects (cf. Kelling and Klemme, 1990).

On-farm experimentation can involve a number of scientific approaches, some more traditional, others falling under the banner of new paradigm research (see below). These methods have in common a belief that the practitioner has at least as much to contribute to the process of understanding biological systems as does the investigator. These approaches are also concerned with much more than the natural environment in which farming takes place. Sociocultural, economic and political factors are all considered to be part of the investigation to obtain a more complete understanding of why certain agricultural practices work. The farmers' objectives as producers are critical to this understanding (Bennett, 1986; Parkhurst and Francis, 1986; Wagstaff, 1987). On-farm research investigations do use statistics, but in a more limited fashion. For example, Thompson and Thompson (1985) and Rzewnicki et al. (1988) have outlined simple field plot designs that are convenient to use on a large scale with normal farm equipment and practices.

The on-farm research model is not foreign to Agriculture Canada or to many of the provincial departments of agriculture. The Prairie Farm

Rehabilitation Administration (PFRA) has, for example, operated Salinity Cooperatives for a number of years. A recognized cooperative of farmers arrange with PFRA to hire a technician to assist in resolving salinity problems faced by coop members. The technicians monitor the development of problems, and make recommendations on agronomic changes. In Québec, agronomes and technicians work with producers in Clubs de Production. At the present time, several are examining particular difficulties facing sustainable agriculture producers, and are developing simple on-farm research experiments to find solutions to problems. This system is sufficiently flexible that a group of producers with similar concerns can band together, determine their priorities, and obtain government support for the hiring of a staff person. In Canadian universities, on-farm investigations have not been explicity encouraged by administrators, although individual professors and graduate students, committed to this concept, have carried out successful studies. The reward and funding systems have made these kinds of investigations more difficult (see Sections 5.2.3 and 5.2.6).

A number of USA states are encouraging the formation of farmer-to-farmer or farmer-to-institution networks with R&D grant programs. Wisconsin, for example, is providing up to US$50,000/yr/project. The state will fund projects in on-farm research, collection of farmer financial data, and demonstrations of management strategies. A related strategy is the provision of support for demonstration days and farm tours, including visits to on-farm research sites. A number of provinces have programs that support demonstration days, and these could be modified to support the demonstration of sustainable practices, particularly integrated systems, as these have received the least attention in existing demonstration programs.

A related initiative is being promoted by the Natural Organic Farmers Association (NOFA) in New England. They are establishing a network of Master Farmers who assume responsibility for research and demonstration projects in their communities. NOFA has received some initial funding from the Low-input Sustainable Agriculture (LISA) program to establish the network.

5.2.2.3 New paradigms: redesign strategies

There is a range of new research methods compatible with an agroecological paradigm and being practiced in science today. Few of these, however, have had an impact on agricultural science. The challenge for agricultural science is to take what is useful from new paradigm investigations in other fields (cf. Reason and Rowan, 1981a; Rogers, 1985) and apply them in an agroecological context. Hopefully, we will evolve a diverse range of scientific approaches that can be applied to problems to which their methods are matched (Aiken, 1986).

The new approaches require that more emphasis be placed on synthesis, and that a variety of techniques be used to collect the information, including, but not limited to laboratory techniques. Observation and basic description of farm processes is essential (Lockeretz, 1985; Parkhurst and Francis, 1986; Patriquin et al., 1986). Useful results can often be obtained without requiring exact precision in the description of events (de Rosnay, 1979; Lockeretz, 1985; Conway, 1986). It is the belief in the need to have a perfect understanding of biological processes that, in fact, prevents many scientists from practicing these new approaches. To know the specific details usually requires highly controlled or ex-situ experimentation under which natural world conditions can not be exactly replicated. The kind of data collection that can be useful to sustainable agriculture research is outlined in Table 57. Reductionist approaches can be a part of this mix but should be used, within any given research program, to shed further light on problems that have been initially identified by more holistic approaches.

One particularly interesting example of this process at work involves attempts by some investigators to integrate conventional agricultural science with an experiential approach known as phenomenology. The modern expression of phenomenology was founded by Edmund Husserl in the social sciences (Hartman, 1967:128-129) and Goethe in the biological and physical sciences (Bortolt, 1986), but it has not been taken seriously by scientists during the last 15 years or so because it is antithetical to the predominant positivist paradigm (Brady, 1977). Douglass and Moustakas (1985) define phenomenology as,

> "... the study of everyday phenomena. Through disciplined focus on the structure of experience (e.g., time, space, materiality, causality, interpersonal factors), the phenomenological investigation attempts to reveal the actual nature and meaning of an event, perception, or occurrence, just as it appears."

Hartman (1967:128) states that, "...it is purely descriptive and analytical rather than experimental, and at the same time it tries to remain free of any epistomological presuppositions." In contrast, conventional science attempts to describe the behaviour of the world by testing

Table 57
Data collection approaches for sustainable agriculture
(adapted from Lockeretz, 1985)

Descriptive studies

Cover such topics as the kind of people who use sustainable practices, the reasons they do so, the methods they use, the institutional setting in which they function, the results they achieve, the problems they face.

Evaluative studies

Try to answer the question "How good is sustainable agriculture?" by comparing with conventional farms such factors as income, yields, production costs, resource use, product quality, pollution, soil fertility, return on effort, and any other objectives that farmers commonly have for farming.

Applied studies

Make better sustainable farming methods available to those who already are farming sustainably or who may eventually choose to do so.

Diagnostic studies

Collect data that might someday be the basis of more general explanatory work. They differ from the evaluative or descriptive categories above in that they are concerned with additional factors besides those that the farmer cares about or is aware of.

Explanatory/Predictive studies

Attempt to synthesize broader principles about sustainable agriculture from the available empirical details in order to help answer the question "How and why do the results observed in sustainable agriculture come about?"

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quantifiable predictions, requiring a separation of our experience from that which we are measuring. The whole cannot be understood in this way, and ecology, as a science of holism, cannot effectively function as a process of investigation unless phenomenological approaches are used for some studies (Brady, 1977).

Patriquin et al. (1986) provide some indications of how phenomenology can be applied to agricultural research. In their observations over an 8-year period of a farm in the process of conversion from conventional to ecological production, they used a mixture of approaches to gain an understanding of the biological processes at work. Plant species were used as windows through which they could understand soil processes. The growth patterns of certain plants became indicators of specific processes that were inhibiting plant growth, inhibitions they were unable, by the time the investigation ended, to confirm using conventional approaches. Other investigators, scientific and popular, have taken a similar approach to examine soil processes (Cocannouer, 1964; Hill and Ramsay, 1977; Walters and Fenzau, 1979). Farmers who have developed precise skills for "reading" the land and their relationship with it, like the one who assisted Patriquin et al., can offer much to phenomenological studies.

5.2.3 Improving reward systems to favour sustainable agriculture research

The dominant system of scientist evaluation is a major obstacle to the development of sustainable agriculture. Reward in most research institutions is determined primarily by publishing record, and quantity is usually more important than quality (Mahoney, 1976; Busch and Lacy, 1983; Madden, 1988; Savan, 1988). This is especially so for young professors trying to advance in universities (Ruttan, 1982), but Agriculture Canada scientists have also identified reward systems as encouraging academic rather than mission-oriented research (Wanczycki, 1984). The pressure to publish means that research projects may be chosen for their publishability, particulary the speediness of publication, rather than for their contributions to our understanding (Busch and Lacy, 1983). It also contributes to conformity because scientists and economists tend to publish on subjects firmly within disciplinary paradigms to which most editors are committed (Busch and Lacy, 1982; Buttel, 1982; Madden, 1988). Although several journals of sustainable agriculture now exist, publishing in them means isolating one's work from the main stream as few colleagues will take the opportunity to learn from these journals. These journals have a lower standing in the discipline-dominated scientific community and they do not carry the same weight during evaluation. Most of the scientists surveyed in the extensive Busch and Lacy (1983) study believed that publication record was overemphasized in evaluations.

5.2.3.1 Reward scientists for all their activities: an efficiency strategy

Because scientists do respond to rewards (Friedland and Kappel, 1979; Dundon, 1982; Busch and Lacy, 1983), these can be used to redirect agricultural research and improve agricultural science education. It is critical that agricultural scientists be rewarded for all the work they do (research, administration, public consultation, preparation of academic and popular articles, and, if employed by a university, for teaching).

The reward system at McGill University provides an example. At McGill, tenure-track professors are told that their work will be evaluated in three categories: research, teaching, and service to the university, which includes administrative, extension, community and other miscellaneous activities. When being evaluated they must demonstrate superior performance in two of these categories and reasonable competence in the third (McGill University Secretariat, 1986). The popular wisdom, however, is that most of the evaluation is based on publication record, which consists of the number of publications in high-profile refereed journals vs. less known refereed and non-refereed journals, number of single vs. multi-authored papers, and the position of the investigator in the authorship hierarchy of any given paper. This approach to evaluation, although easily quantified, does little to reflect the reality of the job. As a result of this emphasis, teaching and other valid activities suffer. Evaluation systems should evolve to be flexible enough to allow scientists who wish to put less emphasis on research and more on teaching and administration to do so (Gouvernement du Québec, 1979; Manwell and Baker, 1986). Many evaluative tools are already in place at McGill for assessing teaching ability and others are being developed for both teaching and administrative performance. A prerequisite for success is the development of clear, specific job desciptions for professors and clearly defined, publicly available standards of excellence that are used as yardsticks to measure performance.

5.2.3.2 Reward activities consistent with a sustainable agriculture approach

To support most sustainable agriculture research, reward systems should generally favour:

- long over short-term projects;
- multi-authored over single-authored papers;
- farmer/extension/scientist/social scientist teams over teams of scientists (many farmers are interested in joining such teams);
- projects with an on-farm research focus or component over a laboratory focus;
- project compliance with the departmental over disciplinary mission;
- high-quality popular (widely read) publications at least at par with high-quality scientific or economic (narrow audience) papers.

A more detailed example is provided in Table 58.

The exception to such reward system criteria is work on basic ecological processes that will help with agroecosystem design. Our understanding of certain pest life cycles, many basic soil processes, and symbiotic plant, and plant - microbe interactions is quite limited (cf. Lowrance et al., 1984a; Altieri, 1987). More basic work on these topics will be necessary before many practical agroecosystem design features can be implemented. Scientists working on these projects may be adequately covered under existing reward systems, although the priority areas may still have to be specified.

Because scientists and economists at Agriculture Canada are working for a department with a specific mission, there exists a greater opportunity than in universities to change the internal reward system to favour research on sustainable agriculture. With Agriculture Canada taking the lead in implementing such systems, and demonstrably providing human and

Table 58
Example of evaluation criteria for research in sustainable agriculture

The project is:	Research evaluated by:
1. Long term Basic agronomic work on crop rotations that enhance soil fertility, prevent pest problems, reduce dependence on imported inputs and cut farm costs (with a research team that may include soil and plant scientists, entomologists, economists, extension agents and farmers).	a. At least 4 publications over a 10-year period in refereed journals. b. At least 4 articles in the popular farm press over a 10-year period. c. Multi-authored papers receive more (or at least equal) credit than single authored papers. d. Publications in multi-disciplinary journals receive more (or at least equal) credit than in disciplinary ones. e. a specific number of presentations to farmers, once useful results have been produced (for example 3/year after year 7 of a project). f. The number of farm adopters in the region 5 years after project ends (Chambers, 1986).
2. Short term To design a vegetable production system in greenhouses that reduces a particular pest problem without producing a negative impact on human health or the environment (entomologist, horticulturalist, agricultural engineer, farmer).	a. 3 publications over a 5-year period in refereed journals. b. 2 presentations/year for last 2 years of project to greenhouse growers. c. Publishing at least half the papers in multi-disciplinary journals. d. equal credit to single and multi-authored papers. e. the number of farm adopters in the region 5 years after the project ends.

* Assuming that a researcher has one long-term and one short-term project at any given time, then the researcher is expected, over a 10-year period, to write at least 10 refereed and 4 popular papers, and to give 13 presentations to growers.

financial resources to such changes, other research institutions will be more willing to follow. The greatest difficulty for Agriculture Canada may be in convincing the Treasury Board that such a reward environment should be created.

5.2.3.3 Some redesign ideas

In the longer term, it has been suggested that reward systems place more emphasis on evaluating the methodologies that scientists use, rather than the results they obtain. Such an approach accomplishes two principal things: a) it shifts the focus of evaluation from quantitative to qualitative factors; and b) it reduces the opportunities for evaluation based on non-rational personal factors because most documented cases of investigator, evaluator, or reviewer bias revolve around the scientist's reaction to the results, and not so much the methods (see Section 5.2.5) (Mahoney, 1976; Truzzi, 1979). A sound process of investigation or a sound teaching methodology is likely to ensure valid results, regardless of what the results are. Related to this is the importance of examining the resources available, or inputs (time, other commitments, finances, assistance), when considering the importance or quality of the methodologies or outputs (Manwell and Baker, 1986), as these factors provide a more comprehensive context for the evaluation.

A further redesign of the evaluation process would involve changing the nature of the relationship between those doing the evaluation and the person being evaluated. In most universities, professors assemble the evidence they feel will convince an evaluation panel of peers and administrators of the merits of their work. There is very little direct interaction between the parties. New systems of personnel evaluation are in place in other institutions that would be much more consistent with the values and objectives of a sustainable agriculture. In these systems, staff and administrators agree on the timing and process of the evaluation and take joint responsibility for carrying it out. Staff engage in extensive self-evaluation and meet with administrators to discuss the outcome of that process. Peers, both those who appreciate and those who have difficulty with the staffperson, are also consulted, but staff have an opportunity to respond to the comments. The spirit of these evaluations is constructive, and the emphasis rests on how performacne can be improved. In this vein, staff may also have an opportunity to comment on administrators' performance.

5.2.4 Broadening participation in the establishment of research priorities

To a great extent agricultural research in the Western world takes place in a policy vacuum (Mellor, 1977; Gouvernement du Québec, 1979; Center for Rural Affairs, 1982; Ruttan, 1982; Busch and Lacy, 1983; Dahlberg, 1986a), and the situation is no different in Canada. The federal government has not articulated a comprehensive set of explicit national goals for the food and agriculture system (see Section 5.1). In the absence of clear, holistic national agricultural goals, agents, other than public ones (scientists, disciplinary associations, commodity groups), step in to dominate decisions about research directions. Individual scientists largely set their own research goals and consider this an academic freedom. Most scientists, however, have confused the right to freedom of inquiry with that of freedom of choice, and have tended to neglect responsibilities to all segments of society. Although scientists should be allowed to pursue research without destructive outside interference (a rare situation at present), this does not mean that they alone should have the right to determine, in broad terms, what research priorities are established (Friedland and Kappel, 1979; Gouvernement du Québec, 1979; Ruttan, 1982), especially in a publicly-funded system. Although most scientists believe that they have the ability to select projects that are the most socially beneficial, studies that have tested this contention have found that scientists have a great deal of difficulty in doing so (Mahoney, 1976; Busch and Lacy, 1983).

Scientists, without a clear public direction, are susceptible to influence from various pressure groups in society. Disciplinary associations and journals often exert a subtle effect on research choice by setting disciplinary standards to which scientists strive (see below) (Busch and Lacy, 1983). Scientists can also be swayed by lobbyists for different commodity groups, industry associations, and by the needs of large farm operators (Hightower, 1972; Hadwiger, 1982; Busch and Lacy, 1983; Brooks and Furtan, 1985; Heffernan, 1986). The availability of funds often affects research choice as scientists adapt their interests to the funding that is available (see below) (Hadwiger, 1982; Busch and Lacy, 1983; Savan, 1988). This is especially problematic when funding is obtained from private sources. Because the agenda of the private firm is not necessarily compatible with the public interest, scientists, knowingly or unknowingly, end up using their publicly supported positions and resources to do private work that may be contrary to the public interest (Vandermeer, 1981; Center for Rural Affairs, 1982; Hadwiger, 1982; Hansen et al., 1986). According to Busch and Lacy (1983:164), "It is all too easy to accept the funding agency's agenda as one's own without further inquiry..." Moreover, scientists working for private firms are likely to adopt the firm's profit goals as their own (Busch, 1984).

5.2.4.1 Solutions

Most of the strategies for identifying clear goals for agriculture and agricultural research have been presented in Section 5.1 (including long and medium goal statements in Table 51 and Appendix 15). Once clear goals have been set, regardless of their stage of evolution (i.e., efficiency, substitution, redesign), mechanisms for ensuring compliance will have to be established. Examples of possible compliance strategies for universities are presented in Table 59. Support and reward approaches are preferable, but penalities might be necessary if some faculties prove to be reluctant participants.

The strategic advantage of this approach to research coordination is its appeal to proponents of both centralized and decentralized research-coordination models. Success is predicated on clear, system-wide identification of research goals, but implementation of the goals is decentralized. This kind of approach was proposed by the Québec government in a green paper on science policy (Gouvernement du Québec, 1979), but it was never fully implemented. Once the redesign of the goal setting process itself is completed, such strategies would be unnecessary, as research institutions would participate fully in the development of the goals and would, therefore, have already expressed their commitment to them.

Table 59
Examples of potential Canadian university strategies to meet research objectives
(adapted from Friedland and Kappel, 1979)

The support approach:

1. The government provides long-term funding for modestly rewarded, 2-year internships for recent Ph.D. graduates in the developing world or in Canada, working with disadvantaged groups within the food and agriculture system (Dundon, 1986).
2. The government provides 10-year funding grants specifically for scientist training in topics and processes of inquiry necessary for doing research in sustainable agriculture.
3. The government provides 10-year funding for an interdisciplinary administrative unit in each agricultural school that demonstrates the operating principles and research processes needed for sustainable agriculture and provides a supportive environment for innovation.

The reward approach:

1. The government provides distinct budgetary support to research on the long-term goals (Table 51) over and above existing levels of funding with the notion that this special support would decline by some percentage within specified time periods for failures to fulfill the research objectives.
2. The government announces to the university that success in allocating 50% of the research budget to fulfillment of the goals within 10 years will increase the budget by 10%.
3. The government, through the research councils, allocates funds to provide discretionary budgets to those organized research units within the university that are especially effective in shifting priorities to projects that support the long-term goals (Table 51).

The penalty approach:

1. Within five years it is expected that the university will be able to demonstrate that 25% of government-funded research is dedicated to two of the specified goals. Failure to demonstrate this will reduce the university's agricultural allocation from government by 5% below the average funding of the previous five years of support.
2. Within ten years it is expected that 50% of the university's government-funded research budget will be dedicated to research on six of the specified goals. Failure to demonstrate this will reduce the government's allocation of research funds by 15%.
3. Within fifteen years, it is expected that the university can demonstrate that 75% of the research budget is dedicated to all of the goals that have been specified by the government. Failure to demonstrate this will reduce the allocation to its maximum penalty of 25%.

5.2.5 Reducing the influence of disciplines

There is tremendous pressure to remain within the confines of the disciplinary paradigm (Kuhn, 1970; Hall, 1974; Busch and Lacy, 1983; Miller, 1983b). Shuh (cited in Madden, 1986b) is particularly concerned about the way in which disciplinary affiliations push scientists away from addressing the really serious problems of agriculture. He contends that disciplinary objectives are often incongruent with the best approaches to problem-solving. The other major problem is that administrative divisions within research instituions (reflecting disciplinary norms), provide little reward for attempting to work with others within or across departments or sections (Gouvernement du Québec, 1979; Ruttan, 1980; Boody, 1982; Lukens, 1984).

5.2.5.1 The role of disciplinary standards

Presently, no agricultural discipline has expressed a serious commitment to sustainable agriculture. In fact, many express serious doubts about its relevance, and this environment discourages many scientists, who might be interested, from expressing their desire to work in this area. Indeed, most established scientists owe much of their success to having faithfully followed conventional approaches. Their salaries are relatively high, they have the respect of their peers, and often exert control over the activities of others within their departments or sections. Naturally, they are resistant to approaches, such as sustainable agriculture, that challenge the orthodoxy that has helped them achieve their present position (Truzzi, 1979; Miller, 1983b; Buttel and Youngberg, 1985;

Savan, 1988). Since many scientists have produced research over the years that is irrelevant to sustainable approaches at best, and destructive at worst, they would have to question the value of an entire lifetime of work (Coleman, 1982; Dundon, 1982). This is an especially difficult task because scientists, particularly during their younger years, have a long history of allowing their self-esteem to become tied up entirely in their research work (Kubie, 1956).

The publication rules established by disciplines also discourage participation in sustainable agriculture research (see also Section 5.2.3). Generally, to have a paper accepted requires that the dominant rules of publishing be followed: have a reputation (particularly important), cite yourself, have positive results, ignore data that does not fit the results, and use an obtuse writing style (Mahoney, 1976 and 1985). Those who have already been published extensively are likely to be rewarded again, even if the quality of the publication is suspect (Merton, 1968; Mahoney, 1976). Clearly, these conditions are difficult for scientists in new research areas, such as sustainable agriculture, to meet.

Ultimately, that disciplines reward this kind of behaviour (and support the positivist, reductionist paradigm discussed in Section 5.2.2), contributes to self-deception amongst scientists. Although self-deception is largely naive and subconscious, outright fabrication and selective use of data and results in order to meet disciplinary standards have been documented (Mahoney, 1976; Nelkin, 1984; Doyle, 1985; Coye, 1986; Savan, 1988). For the most part, however, self-deception occurs because scientists often fail to realize or examine their assumptions, the limitations of their work, and the influences of their subconscious agendas.

Self-deception suppresses innovations, such as sustainable agriculture approaches, because scientists, unwittingly, tend to design experiments to confirm already held beliefs (Kuhn, 1970; Mahoney, 1979; Savan, 1988). They do this by selectively choosing: a) the literature on which they base their propositions and experiments; b) the problems and the variables to be examined; and c) the data they report (Kuhn, 1970; Mahoney, 1979; Dundon, 1982; Miller, 1985a). As well, many are not swayed by evidence contradictory to their hypotheses, no matter how convincing it is (Mahoney, 1976; Savan, 1988). Consequently, self-deception reinforces the orthodox position and limits the potential for new ideas to come to the surface.

Unfortunately, self-deception may also be seen in sustainable agriculture literature as scientists in this field attempt to convince their conventional colleagues of its merits. This situation is likely to continue until alternative approaches receive more support within established scientific institutions.

But, the most devastating result of disciplinary conformity is that scientists pursuing alternative approaches have been ignored, ridiculed, and persecuted by their colleagues. Many documented cases exist of scientists who have been threatened with loss of funding, promotion denial, and even dismissal for following research directions that did not conform to the disciplinary paradigm or to the proprietary interest of the private funding agency (Fujimoto and Kopper, 1975; Mahoney, 1976; Hadwiger, 1982; Paigen, 1982; Busch and Lacy, 1983; Nelkin, 1984). More worrysome is the widespread acceptance among alternative agriculture researchers that such discrimination is inevitable. The results have been compromise, secrecy, timidity in publications, isolation in peripheral institutes, dependence on alternative sources of funding, postponement of the training of more holistic scientists, and even a return to the orthodox fold (Dundon, 1986). The paradox of these situations, as discussed in a number of studies reviewed by Manwell and Baker (1986), is that scholars investigating alternative or "radical" subjects often demonstrate superior research performance.

5.2.5.2 Working alone

The classical image is one of the scientist working alone (Mahoney, 1976; Savan, 1988). The administrative divisions of universities usually reduce communication (Sonntag and Klein, 1977; Ruttan, 1980; Hadwiger, 1982; Busch and Lacy, 1983), and research administrators rarely push for interdisciplinary efforts (Gouvernement du Québec, 1979; Caye and Sachs, 1982; Hadwiger, 1982). Working with others has been seen as the summation of individual work rather than an integrated problem-solving effort using the expertise of people from different backgrounds (Buttel, 1982; Miller, 1983b). There has been little attempt to teach scientists how to work in teams (Busch and Lacy, 1983; Miller, 1983b), or to help farmers and scientists work together to incorporate scientific information into a farm system (Hanway, 1978; Bennett, 1986). There is also the fear of having to suppress one's personal goals and identity. Because sustainable agriculture is such an interdisciplinary enterprise, there is a strong need for interdisciplinary team work and its associated relative anonymity. Most scientists, however, are resistant to sharing any information that they consider to be critical to their career development (Mahoney, 1979; Busch and Lacy, 1983), and they do not wish to subordinate their personal goals to those of a team (Miller, 1983b). These problems become particularly acute in the field of biotechnology where there is substantial money to be made through patents and royalties. A number of investigators have commented on the increasing reluctance of biotechnology researchers to cooperate and share information with their colleagues (Yamamoto, 1982; Nelkin, 1984; Buttel, 1986b; Hansen et al., 1986).

Sustainable agricultural research clearly requires that scientists work with each other and with farmers, yet there has been little successful institutionally-designed, multidisciplinary work to date. Bahm (1979) has concluded that we are unlikely to see truly efficient interdisciplinary work until experience has produced competent managers and investigators. Success to date has largely depended on the initiatives of the scientists and farmers involved.

5.2.5.3 Solutions

Solutions to overcome many social, organizational and psychological obstacles have been outlined in previous sections. An educational program, such as the one outlined in Section 5.2.1.3, can go a long way toward overcoming such barriers. Changes to reward systems can also do much to change the influence of conventional disciplinary associations. Hill (1987) has described some possible counseling tools that could be used to help scientists to understand how emotional traumas might affect both their perceptions of agriculture and their relationships with other professionals.

The evidence suggests that working with others is more productive and that creative scientists tend to consult outside of their own discipline (Mahoney, 1979; Busch and Lacy, 1983). Assembling a multidisciplinary team is a delicate and critical task. There is a need to preselect participants who have a predisposition to working with others and to being trained (Caye and Sachs, 1982; Miller, 1983b). The team must be assembled right from the beginning of the investigation because the process of problem formulation is often the most difficult and important aspect of multidisciplinary work (Miller, 1982; Bradfield, 1986). Many questions must be asked including: what are the root causes of the problem; the short- and long-term costs and benefits of proposed solutions; the time and resources required; chances of the recommended innovation being adopted by the farmer; the risks associated with adoption; and the local and regional impacts of widespread adoption (Parkhurst and Francis, 1986). These questions are best examined if all members of the team have opportunities to make an input. Reason and Rowan (1981b) and Miller (1984) have suggested that the identification of interpersonal problems and solutions can be facilitated from within a multidisciplinary team by the presence of an individual whose explicit role is to help bring out the hidden assumptions of team members. A multidisciplinary team also needs an effective facilitator who is well trained in conflict resolution (Caye and Sachs, 1982).

Administrative units, designed around research problems, have been partially successful at bringing researchers from different disciplines together in many research institutions (Gouvernement du Québec, 1979), but most universities are still administered along disciplinary divisions. Some moves have been made by universities to integrate disciplines and approaches. The University of California at Santa Cruz has had a Project on Social Impact Assessment and Values (Friedland and Kappel, 1979), and UC -

Davis has successfully mixed basic and applied scientists in one administrative unit (Madden, 1986a). Caye and Sachs (1982) strongly recommend that these multidisciplinary units have control over their own budgets.

5.2.6 Changing the funding of agricultural research

Funding in agriculture has been tied, from the outset, to utility and productivity (Hadwiger, 1982; Busch and Lacy, 1983; Guitard, 1985; Danbom, 1986). Unfortunately, there has been little support for the kind of basic research that is central to sustainable agriculture (Levins, 1973; Hadwiger, 1982; Busch and Lacy, 1983; Buttel, 1986a), and the situation may not improve as universities, with the incentive of industry funding, pay more attention to biotechnology research (Buttel et al., 1986; Hansen et al., 1986; Office of Technology Assessment, 1986). Agriculture Canada's shift to support for industrial partnership research funding is not supporting sustainable agriculture research, as few of such projects offer the kinds of commercial rewards that are likely to attract an industrial partner.

One reason for a continuing commitment to funding research that improves productivity and efficiency is that most of the numerous studies evaluating the benefits of agricultural research have concluded that sizeable returns on investment exist (Prentice and Brinkman, 1982; Ruttan, 1982). Many of these studies, however, are marred by methodological problems concerning the measuring of productivity (Arndt and Ruttan, 1977), the limited criteria that have been used to measure benefits (Hadwiger, 1982), and the many costs and negative impacts of agricultural research that have been ignored for reasons of immeasurability or investigator bias (Arndt and Ruttan, 1977; Hadwiger, 1982; Madden, 1986a). Furthermore, very few studies have actually examined the distribution of research benefits throughout society (Carter and Lohr, 1986; Madden, 1986a). The critics conclude that benefits from conventional agricultural research have been overestimated and that they serve selected groups within society, yet funding administrators have been slow to reform funding programs.

Busch and Lacy (1983), in their survey of agricultural scientists in the USA, found that low funding levels make scientists insecure about pursuing alternative research projects. In particular, in a transition context, it creates difficulties changing research directions. Once personnel have been hired and equipment purchased they must be kept occupied or maintained (Muller, 1980; Center for Rural Affairs, 1982; Dundon, 1982), so long-term assurances of funding are essential to establish a new research area.

Muller (1980) has characterized most government research funding agencies as adverse to risk taking, too reliant on a clear consensus about a project's perceived merit, and overly compartmentalized. He feels therefore that innovative work does not get funded as frequently as it should, that cross-disciplinary proposals fall through the cracks and, ultimately, that scientists choose topics for which they can anticipate either the results or the economic impact. Grierson (1980) has gone so far as to suggest that results must be virtually guaranteed for projects to be funded. As well, the period of funding is often too short (Muller, 1980; Sanders, 1982; Busch and Lacy, 1983; Buttel, 1986a), discouraging scientists from undertaking long-term studies, the kind that are essential to furthering our understanding of sustainable agriculture. Three-year funding terms, common to many funding agencies, are too short to evaluate such things as the impact of agricultural practices on soil organic matter (MacRae and Mehuys, 1985), or to determine the most effective crop rotation for minimizing soil erosion and preventing pest attack.

The peer review system has also been criticized. Although the goal of peer review is to avoid insularity and bias in the development and funding of research proposals, there are some doubts that this goal is achieved (Gouvernement du Québec, 1979; Davis, 1986; Savan, 1988). Researchers in the USA have found that eminent scientists tend to be less stringently scrutinized than those who are not as well known, and that young scientists with innovative ideas are less likely than established scientists to be looked upon favourably by reviewers (Sanders, 1982). Savan (1988) reached similar conclusions in Canada. She stated that those scientists who sit in judgement of others are usually the best funded by the research council, and it is young and innovative scientists who suffer. Established scientists will naturally defend and support research projects that they understand and with which they are comfortable (Fineman, 1981). There is a fair degree of chance in the peer review process and funding agency coordinators, by their choice of reviewers, may determine a proposal's chances of acceptance (Cole et al., 1981; Manwell and Baker, 1986). Where there is a large pool of reviewers from which to choose, Cole et al. (1981) concluded that few problems exist. Québec, however, faces a unique problem in Canada. There are a limited number of scientists in many disciplines, and the requirement for fluency in French further limits the number of potential reviewers, so the chances of projects being refused funding on the basis of the personal values and biases of a small group of scientists is higher. Similar problems exist with publication peer review systems (Mahoney, 1976; Manwell and Baker, 1986; Savan, 1988). Coye (1986) has claimed that the peer review process can be subtly subverted by industrial interests. It is her contention that some industry funded research programs are partly designed to make funds available to those reviewers likely to be involved in reviewing projects of financial interest to the company.

5.2.6.1 Some efficiency strategies

In the present economic climate, government is unlikely to provide more total financial support for research. Strategically, then, it is important to identify the kind of research that should and should not be supported.

Government should no longer provide support for projects that are only of immediate benefit to a few agribusiness firms. If this type of research is to be done by universities it should be paid for by the firm itself, with a provision for the overhead costs that the university often is required to pay for out of public funds (Hightower, 1972; Friedland and Kappel, 1979; Marshall, 1980; Busch and Lacy, 1983). If this criterion had been applied several decades ago, such things as mechanical tomato harvestors, some plant variety testing, some poultry feeding trials, and some food processing technologies would not have been paid for with public funds. This criterion also has implications for agricultural biotechnology research. Work that produces patentable products in the short term is likely to be an economic boon to a small number of agribusiness firms and, therefore, should be paid for by the firms themselves. If government is to fund biotechnology, the emphasis should be on long-term, basic biotechnology research that has broad benefits and application to sustainable agriculture (Buttel, 1986a; Hansen et al., 1986).

In general, funding agency staff are not encouraged to provide supportive, constructive feedback, but rather a judgmental evaluation, nor are they asked to support projects that are innovative or multidisciplinary (Muller, 1980; Fineman, 1981; Hadwiger, 1982; Ruttan, 1982; Savan, 1988). A first step would be to allow each administrator a small fund (say 10% of the funds over which the individual is responsible) to distribute to innovative projects that do not have the expectation of success normally required by granting agencies (Muller, 1980).

In the long term, as scientific institutions become more supportive of sustainable agriculture, less research money will be spent on solving problems that other research has created. Such problems as soil degradation, water pollution, inefficient energy use, and health problems associated with the use of agricultural chemicals and antibiotics -- what Hodges and Schofield (1983) call `agricologenic diseases' -- are conditions that our agricultural systems and agricultural research have created. Sustainable agriculture is unlikely to produce the economic and environmental problems that conventional agriculture does (see Sections 1.5 and 1.6). Provision of more funding to projects that evaluate strategies for overcoming and preventing problems would speed up this process. Freudenberger (1986) estimated that only 2% of the agricultural projects funded in the USA fell into this evaluative category.

5.2.6.2 Some substitution strategies

On-farm agronomic trials, and other forms of decentralized research, can be less expensive than some of the agronomic work done on university farm plots (Evenson et al., 1979; Madden, 1986a). Trials can be designed to make use of the work the farmer would normally do, thereby reducing the need for labour and materials, e.g., seedbed preparation, planting and cultivation, sampling, and observation. The work of Patriquin et al. (1986) and Samson et al. (1989) provides examples of useful field experiments that although inexpensive are of great value to the farm community. Participatory research could be funded partly by the co-investigators or farm associations that benefit from the research (Fineman, 1981). For example, an association of biodynamic farmers in Germany hired two researchers to perform on-farm research to help solve the problems of the association's members (Groh, 1985).

A funding program designed specifically to meet the needs of sustainable agriculture research and researchers would also be very useful. Although the model is not directly transferable to Canada, the Low-input Sustainable Agriculture (LISA) program in the USA could provide lessons for the implementation of such a program. The LISA program has been successful in generating useful projects on sustainable agriculture because: a) selections were made by regional committees that understood the needs of the region; b) participation in the selection committees was broadened to include knowledgeable farmers and extension personnel in addition to scientists, and it was required that farmers be involved in the design and implementation of the research program; c) the specific acknowledgement by

Congress that this kind of research is important has made scientists feel more secure about expressing their interest in participating in sustainable agriculture research (Patrick Madden, Manager, LISA program, pers. comm., Feb. 1989; Morgan, 1989b).

Points b) and c) are particularly important with regard to initiatives that could be taken in Canada (regional decision-making structures are already in place for some programs). A further initiative to strengthen the process would be to have a 2-stage funding mechanism where the first stage (of 6 months to a year) would be for proposal development. By requiring broad review of the existing literature, and extensive communication with farmers and extension personnel, a funding agency can assure that the most pressing problems will be addressed in the research program.

5.2.6.3 Characteristics of a redesigned funding framework

Several of the efficiency and substitution proposals contain characteristics of a redesigned funding framework for agricultural research. The development of a redesigned approach is also dependent on implementing the redesign strategies discussed in Sections 5.2.1.3.1 and 5.2.6.3. A funding mechanism that truly supports sustainable agriculture would have the following characteristics:

1. A mix of competitive grants (scientists compete for funds) and block grants (funds are provided to an administrative unit to be divided amongst the staff). Existing block grant systems appear to be more suitable for the support of innovative, multidisciplinary, and long-term work because of the current weaknesses of the peer review system (cf.

Sanders, 1982), but substantial modifications to the administratiion of research in institutions would need to be made to make block grants suitable in a sustainable agriculture context (see the discussion in Section 5.2.5).

2. Many projects must have guaranteed funding for longer periods of time, but this does not imply greater expenditures in comparison to current practices. With participant co-funding and on-farm trials as key components for the research strategy it would be possible to use equivalent funding levels for much longer periods of time.

3. Project evaluation periods should be consistent with the periods in which significant results can be expected. In rotation studies this may be every five years. The evaluation process should be a participatory one similar to that for reward systems described in Section 5.2.3.3, including self-appraisals by the scientists involved and evaluations from the non-scientist co-participants in the study.

4. Non-scientists must be involved in the evaluation of research proposals at their level of competence. This could involve farmers, business people and policy makers, depending on the project submitted.

5. Funding agency staff should have a discretionary budget that permits them to take chances on projects that appear to be particularly innovative, but may not return any useful results.

6. Funding agency staff should play a facilitative rather than strictly administrative or evaluative role. Such a change permits them to be full partners in the development and implementation of a project.

5.2.7 The redesign research agenda

Many areas of sustainable agriculture have received little research attention for many of the reasons outlined above. Ten of these areas and some thoughts on the kind of research methodology required are discussed here.

1. Indicators of soil excesses and deficiencies. Such experiments require multidisciplinary teams of soil scientists, botanists, plant and animal scientists and farmers. Scientists must rely heavily on observation and phenomenological investigation, using soil, tissue and animal analyses for corroboration in some instances. Farmers may play a critical role in observing different phenomena.

2. Lifecycles of poorly understood insect pests. Such investigations involve basic zoological and entomological research and benefit from the presence of soil and plant ecologists who may help to explain certain features of the insect's lifecycle in an agricultural context.

3. Design of animal environments based on ethological principles. These typles of experiments require multidisciplinary teams of animal scientists, ethologists and engineers. They also rely heavily on observation and phenomenological inquiry.

4. Implications of widespread conversion on land use and the agricultural economy. These investigations involve land use specialists, economists and sociologists. The limiting factor at present for must professionals in these disciplines is an absence of training in agroecology. Because such investigations are so global in nature, an agroecological paradigm is essential for success.

5. Design of transitional rotations for a variety of production sectors and economic and ecological conditions. These require multidisciplinary teams including agronomists, economists and farmers. The most valuable information is generated in on-farm trials and observations, but research station plots and some economic modelling may be useful to explain certain elements of the success or failure of different rotations.

6. Optimal design of orchard environments, particularly to prevent the development of pest problems. These investigations require horticulturalists, entomologists, soil scientists, landscape designers, forest ecologists (for interactions with adjacent areas), and farmers. These may be very long-term trials, and case studies of successful models.

7. Design of soil management systems that optimize food quality characteristics. These kinds of experiments may present the greatest methodological challenges. The number of soil, plant, animal, and climatic factors that may influence food quality indiate the need for holistic inquiry. Bioassays may be the most promising initial investigative tools, with more traditional analyses being used to confirm or contradict findings from the bioassays.

8. Design of alley cropping systems for North America. Some interesting work has been performed in the developing world, much of it in on-farm investigations involving farmers and multidisciplinary research teams.

9. Design of the optimal Canadian diet and implications for food system design. This kind of investigation involves nutritionists, planners, policy analysts, agronomists and economists. An agroecological paradigm is essential.

10. The city as a source of food production and soil nutrients. In addition to a full range of agricultural professionals, such investigations involve urban and transportation planners, pollution control experts, sewage engineers and citizen groups. Extensive study of existing success stories from different parts of the world would be a critical component of such inquiries.

5.3 Agribusiness

The discussion in this section focuses on four different aspects of the transition. As in Section 5.1, the emphasis here is on efficiency, substitution and redesign of the content of decisions, and on the redesign of certain aspects of organizational process. Instead of discussing the redesign of organizational management, which has already been discussed in 5.1.3.5 with regard to government process and is widely written about in business management literature (cf. Peters and Waterman, 1982; Naisbitt and Aburdene, 1985; Peters, 1987b; Evans and Russell, 1989; and Pascale, 1990), the emphasis is placed on examples of alternative, redesigned business forms and on the need to design an ecological economics.

5.3.1 Overview of the problem

Most agribusiness firms, particularly large ones, when measured against the goals outlined in Table 51, have not been making significant contributions to the attainment of sustainable agriculture in Canada. In spite of the interest of many business people, the organization of agribusiness activity (and the societal and economic values that firms feel they reflect in their activity) is limiting the transition. The central feature of this activity is its centralized nature. In this section the implications of this centralization is discussed.

5.3.1.1 Control and dependency

A key element of large agribusiness firm activity is reducing risk by controlling its input and output market. This control is commonly achieved by vertical and horizontal integration. The acquisition and maintenance of market share is also generally seen as central to achieving profitability (Teece, 1988), and it permits "a firm to raise the price of its product above the level that [it] would obtain if its market were more competitive" (Parker and Connor, 1987:233).

Corporate concentration in Canada is higher than in most other industrial nations, although the implications regarding control and dependency are in dispute[30] (cf. Royal Commission on Corporate Concentration, 1978; Francis, 1986; Royal Commission on Economic Prospects for Canada, 1986; Khemani et al., 1988). Ownership of large firms is generally not widely held (Khemani, 1988), especially in the agrifood sector where many of the largest firms are family owned or controlled, and under no or limited obligation to report on their activities and financial performance (Mitchell, 1975; Giangrande, 1985; Francis, 1986; Davies, 1987; White, 1990). Corporate concentration exists in most sectors of the Canadian food and agriculture system, especially in fruit and vegetable canning, frozen fruit and vegetable processing, confectionary, soft drinks, biscuits, and distilleries and breweries (Hazeltine, 1989) . Some figures on market concentration (the evaluative tool used most consis-

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30. This dispute is partly a function of the debate over how to measure and evaluate corporate concentration and its impacts (cf. Marion, 1986; Green, 1987; Hazledine, 1989) .

tently for evaluating concentration according to Khemani [1988]) are provided in Table 60.

Many aspects of corporate concentration are inconsistent with sustainable agriculture goals. For example, corporate concentration has been linked with reduced farm payments, higher farm input costs, and higher retail prices for consumers. In the USA[31], correlations have been found between market share controlled by the few largest firms and declining prices for farmers in cattle and hogs (Strange, 1988a). Similar correlations have been found between vertical integration in the cattle, broiler and egg industries and consumer prices (Greene, 1976; Strange, 1988a). According to the USA Trade Commission statistics, corporate concentration has also resulted in higher machinery and feed prices (Vogeler, 1981). Parker and Connor (1987) estimated that corporate concentration in the USA food manufacturing sector cost American consumers $10-15 billion in 1975, about 6% of household food expenditures. Excess profits resulting from the market power of leading food retail chains have also been identified (Lerza and Jacobsen, 1975; Marion et al., 1979).

Canadian studies have been less conclusive[32] (Coffin, 1987), even though corporate concentration in the Canadian agrifood sector is greater than in the USA (Warnock, 1978; Lanoie, 1986). Some analysts have concluded that Canadian consumers have paid more for food as a result of

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31. USA studies are pertinent because of the degree of influence of the American agrifood economy, and of American firms, on the Canadian agrifood sector.

32. The exercise of market control in Canada, or at least finding evidence of it, may be complicated by lower efficiencies and greater exposure to international forces in comparison with the USA (Coffin, 1987). Additionally, the Canadian government's record keeping and analysis of corporate concentration is considerably weaker than that of the USA (Francis, 1986).

Table 60
Figures on corporate market concentration in different sectors of the Canadian food system

Sector	Degree of concentration[a]	Date	Source
Retailing	5 chains control: 55% of retail stores; 70% of sales	1987 1987	White 1990 Winson 1988
Wholesaling for supermarkets	4 buying groups control 85% of all retail sales	1982 (revised 1990)	Giangrande 1985 Christianson, pers. comm., 8/90
Vegetable canning	4 firms control 40% 1 company controls 82% of canned soup market	1982 1980s	Coffin 1987 White 1990
Potato processing	2 firms control 60% 1 firm controls 90% of french fry market	1982 1989	GATT-Fly 1982 Bertin, 1989d
Meat packing	4 firms control 40%	1982	Coffin 1987
Poultry processing	4 firms control 37%	1982	Coffin 1987
Brewing	4 firms control 99%	1982	Coffin 1987
Biscuits	4 firms control 74%	1979	Hazletine 1989
Dairy products	4 firms control 40%	1982	Coffin 1987

[a] If 4 or fewer firms account for a minimum of 40-50% of the market, it is considered concentrated (Consumer Reports, 1975; Warnock, 1978; Parker and Connor, 1987).

concentation in the retail sector (Mitchell, 1975; Warnock, 1978; Coffi: et al., 1989). Market power has been used by food manufacturers to lower prices to producers (Coffin, 1987), and by farm equipment firms to raise the prices of their product (Warnock, 1979).

As an outcome, many farmers are caught in a cost/price squeeze, and the numbers of farms and farm operators declines[33]. Consumers have paid more, but the extra money has not been passed on to farmers. In fact, the percentage of the consumer dollar going to farmers has been declining for many years (Warnock, 1978), and is now only 30-35 percent (Eric Johannsen, Agriculture Canada, pers. comm., June, 1989). Higher consumer prices have created financial burdens for low-income people and isolated communities (cf. People's Food Commission, 1980). Wealth has been transfered to fewer people (Nader et al., 1976; Francis, 1986).

A related problem is the reduction in diversity associated with the elimination of farms, concentration of farm units, and decline in the numbers of businesses operating in different regions of the country. For ezample, there are only half as many establishments in food and beverage manufacturing as there were 25 years ago (Coffin, 1987). Much of the concentration in the food sector has come about as a result of the cascading and progressive takeover or elimination of smaller, local, regional and national firms by multinationals (cf. Mitchell, 1975; Warnock, 1978; Davies, 1987; Kneen, 1990). These large firms are able to maintain their dominance, and hence limit diversity, by creating an environment un-

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33. Some argue that global economic factors are the major contributors to low farm incomes and loss of farms, but the negative impacts of the global agricultural economy cannot be divorced from the rise of multinational firms and global corporate concentration (cf. Barnett and Muller, 1974; Burbach and Flynn, 1980; Sachs, 1986; Warnock, 1987; Clairmonte and Cavanagh, 1988).

suitable for new entrants. Employment in the agrifood sector has been reduced as a result of monopolistic activity (Francis, 1986).

A further significant effect of corporate concentration is the increased power of firms to modify consumer behaviour in order to ensure a predictable demand for products, and the associated reduction of real purchasing choices. This is achieved by advertising (cf. Leiss et al., 1986; Singer, 1986), brand differentiation (cf. Kneen, 1989a) and, at the retail level, by subtle manipulation of consumers within the supermarket (cf. White, 1990). Consumers do not receive full information (quality, production and processing, ownership) about the products they are buying[34].

5.3.1.2 Excessive political influence

There is widespread concern that large corporations threaten the democratic process by exerting excessive influence over government decision making. This political power is generally expressed through four actions: electoral contributions, interlocking networks of friends and peers, regular movement of employees between senior government and business positions, and employment of lobbyists or government affairs consultants (Nader et al., 1976; Adams and Brock, 1986). Some controls over electoral contributions exist, but corporate access to the levers of power by means of the other elements has been well documented (cf. Porter, 1965; Newman, 1979; Francis, 1986; Davies, 1987; McQuaig, 1987; Sawatsky, 1987; Stanbury, 1988). Newman (1979:214) concluded that, "The corporate order

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34. There is considerable debate about how much information consumers are able or willing to absorb. Traditional models of consumer behaviour do not account for the growing interest in environmental issues as expressed in purchases (cf. Padberg and Westgren, 1983).

is a system of private governments lacking the restraints of public accountability".

5.3.1.3 Environmental and health problems

The pursuit of profit through specialization and control has produced a very centralized food distribution network in Canada. Raw materials and final products are transported over great distances. One USA study estimated that the average food molecule travelled 1300 miles (Cornucopia Project, 1981), and the figure may be higher in Canada because of our greater area and extensive reliance on food imports. This kind of distribution system requires crop uniformity in terms of maturation period, size and grade of product, quantity and timing of supply, storage, and packaging. Some specific examples of the implications of a centralized food distribution system are provided in Table 61.

Some firms have also been significant polluters, particularly synthetic chemical fertilizer and pesticide manufacturers. Acute and chronic pollution events have been reported, including waste emissions from manufacturing facilities (cf. Marquardt, 1989a), and promotion of farming practices (i.e., application rates of fertilizers and pesticides) that lead to pollution of soil and groundwater[35]. It is now well-documented that chronic exposure to pesticides presents health hazards to pesticide plant workers, farmers, farm workers and consumers (cf. Coye, 1986; National Research Council, 1987; Blair, 1990). Many documented cases exist

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35. Scientists and extension agents have also been very involved in promoting such practices. See Section 5.2.1.2 for a discussion of why many have tended to follow an agribusiness agenda.

Table 61
Examples of how food quality and the environment have been affected by centralized food distribution

Action to accommodate centralized distribution	Consequences
<u>Food quality</u>	
Tomato breeding to increase thickness of skin; for easier transport	Decline in vitamins A,B,C,D (People's Food Commission, 1980; Doyle, 1985)
Chemical oxidizing agents to stiffen proteins; to permit rapid beating of dough	Presence of synthetic food additives in food (Hall, 1974)
Ground up, beaten and heated (processed) cheese; facilitates easy packaging and longer shelf life	Low food value (Warnock, 1978)
Importation of fresh produce from California in off-season	Loss of nutritional value during transport (Kramer, 1989)
Broilers confined in cages in very large facilities; to ensure rapid controlled growth	Reliance on sub-therapeutic doses of antibiotics to reduce incidence of disease, and development of salmonella poisoning in humans (Holmberg et al., 1984)
<u>Environment</u>	
Very energy expensive distribution	Consumption of non-renewable resource fuels and associated atmospheric pollution (cf. Perelman, 1976).
Contracts specifying date of harvest to comply with processing schedule	May lead to soil degradation if soil is too wet (cf. Giangrande, 1985; Winson, 1988)
Concentration of beef animals in large feedlots	Manure disposal problems (cf. Poincelot, 1986)
Crop uniformity and uniform planting patterns to facilitate mechanical harvesting	Simplified agroecosystems and associated ecological problems (cf. Hodges and Schofield, 1983; Hill, 1985a; Kloppenburg, 1988)
Use of late maturing, high-yielding potato varieties to meet created cosmetic consumer demand	Leaves few rotation options, resulting in soil degradation (cf. Kneen, 1988)

of agribusiness firms attempting to cover up evidence demonstrating the health hazards of their products (cf. Bouguerra, 1985; Epstein, 1989).

5.3.1.4 Decline of rural communities

The negative impacts of centralization and corporate control are experienced by rural communities, directly by physical changes to the community associated with a depressed economy, and indirectly in the subtle impacts of agribusiness activity on rural culture. Detailed treatments of this process have been provided by Berry (1977), Rodefield et al. (1978), Vogeler (1981), Troughton (1985), Heffernan (1986) and Kneen (1989a).

Corporations are interested in homogenizing the values and desires of the population in order to increase demand. Because economic resources and markets are most often concentrated in urban areas, this homogenization involves the transferral of metropolitan values to rural areas (Galbraith, 1967; Levitt, 1970). Advertising urban products and lifestyles is a critical component of this process (cf. Leiss et al., 1986). In concert with other forces (eg., ex-urbanization, transportation and communications technologies), these activities have contributed to an atmosphere in which many young people question the value of remaining on the farm, or even in rural areas. The ultimate consequence is rural depopulation.

The loss or consolidation of farms has had a negative impact on rural population, business and social activity (Fujimoto, 1977; Vogeler, 1981; McClatchy and Abrahamse, 1982; Heffernan, 1986: Pugh, 1987b; Batie and Taylor, 1989), although some communities have managed to adjust to changes in the agricultural sector and have retained their vibrancy (cf.

Dahms, 1985; Vail, 1987). Unfortunately, in many communities, the loss of friends, businesses and rural services, together with the depressed farm financial situation, has resulted in elevated levels of depression, family breakdown and suicide (Haverstock, 1987; Walker and Walker, 1988).

5.3.1.5 Lost opportunities to finance other initiatives

There exists considerable debate about the value of public and private initiatives to support agribusiness activity. Subsidies to agribusiness have received the most attention (cf. Mitchell, 1975; Francis, 1986; Kneen, 1990), and have been critized on many levels, including the extent to which they represent an opportunity cost for the support of sustainable agriculture. Two other areas, availability of capital and the tax system, have received less scrutiny and are discussed in this section.

5.3.1.5.1 Capital

Large firms, including agribusiness (cf. Connor and Geithman, 1988), have relied increasingly on debt financing, particularly during this recent merger and acquisition wave. Many analysts question the ability of firms to repay, and fear negative consequences will result regarding the financing of other initiatives (Uchitelle, 1988). This phenomenon, in concert with the deregulation of financial institutions, undermines the financing of sustainable agriculture. For example, banks are the largest single suppliers of credit to farming (about 40%), but they prefer to loan to enterprises with an established record (Agriculture Canada, 1983). Adoption of sustainable agriculture practices is fairly recent, and many operations appear to lenders to be of higher risk (Henning et al., 1990). Concentration is increasing in the financial sector with the result that small enterprises may not receive the service they need, especially with regard to seed capital (Congressional Research Service, 1983; Carlisle, 1987; Aarsteinsen, 1988; Courchene, 1988). Credit decisions are becoming increasingly centralized (not locally made, which would benefit organic farmers), and the cost of credit is likely to be higher and more volatile as banks pass on the costs of their risk taking in a more competitive and uncertain environment (Office of Technology Assessment, 1986). Because farm loans make up less than 7% of all general bank loans (Canadian Federation of Agriculture, 1983), farmers may find themselves neglected in a credit-short environment. There are indications that the banking industry in Canada is becoming more reluctant to participate in the market for agricultural credit, and, in this environment, there is a danger that farmers practicing sustainable agriculture, already low on the lending pole because their operations are least understood, would be the first to suffer. This situation is aggravated by the existence of interlocking directorships between financial institutions and large corporations. Some analysts fear that large corporations will have privileged access to credit at the expense of less familiar clients, and that the chances of self dealing will be increased (Francis, 1986; Courchene, 1988).

5.3.1.5.2 Lost tax revenues

According to Kierans and Stewart (1988), the federal government had allowed, by 1984, the largest Canadian corporations to defer indefinitely $27.6 billion in corporate tax liabilities, up from $3 billion in 1969.

They deemed this "a peculiar policy in a nation with heavy surpluses of human resource and a chronic shortage of capital" (p. 133). Large corporations did not pay any 1984 tax on $10.6 billion in dividends from marketable securities. These tax "expenditures" are not subject to the same scrutiny as other government expenditures, nor have they been proven to be particularly beneficial to the economy (McQuaig, 1987; Ternowetsky, 1989). The situation for large agribusiness firms is not clear, but 1983 data from Wolfson (1988) suggest that the agribusiness sector has a lower effective tax rate than most other industrial sectors. This lower rate could be partly accounted for by tax deferrals. Wealthy individuals, including many of the families that control agribusiness firms, have also been great beneficiaries of the tax system (McQuaig, 1987).

5.3.1.6 Deficiencies of current bottom line calculations

There is a growing perception that the economic concepts on which business activity rests are not capable of fully recognizing the value of sustainable agriculture and rural communities. This perception has been reflected in a number of detailed critiques of the current economic system (Georgescu-Röegen, 1971; Schumacher, 1973; Henderson, 1981; Robertson, 1983; Ekins, 1986a; Callicott and Lappé, 1988; Kierans and Stewart, 1988). The following criticisms are particularly pertinent to this discussion.

1) Our present economic system only measures a limited portion of human activity. There have been few attempts to effectively measure, for example, household activity or voluntary contributions to a community. Many rural communities in Canada survive on this "informal economy" (Nicholls and Dyson, 1983). There is growing momentum within rural

communities to develop a supportive framework for rewarding a full range of human and economic activities.

2) Private firms have externalized many of the costs of environmental degradation and non-renewable resource consumption, as part of the search for lower costs. Conventional theory holds that internalizing these costs places a firm at a competitive disadvantage unless everyone does it. Organic farming, however, is one example of how this is an incorrect assumption. Successful organic farmers internalize some of these costs (Breimyer, 1984), and are profitable (see Sections 1.5 and 2.5). Premium prices for organic produce partly reflect the costs of internalizing these negative effects, because many consumers recognize that, in these production systems, the food is less likely to be contaminated and environmental degradation is minimized. Beyond this, organic farmers are providing a "public good", because the benefits of their farming practices extend far beyond the farm to the public at large. Government programs and policies, agribusiness firms, and most economic institutions rarely recognize this. This market failure suggests the need for a new approach in which production and marketing systems are designed so that they support the internalization of these costs, and acknowledge the important public benefits of organic farming.

3) The new approaches in economics reject the assumption that price is an adequate measure of value, and that market activity is only motivated by narrow self-interest. The purchase of organic food, for example, can be motivated by concerns for health, environmental degradation, and the quality of life for future generations (see below).

4) Neoclassical economics suggests that when the relative wage rate rises, firms should substitute capital for labour until their relative

internal costs just balance their relative marginal productivities. This occurs, however, without concern for the short-run external unemployment costs to the community. The new approach is to actively promote employment possibilities and to keep capital and operating costs low. It makes a clear distinction between human and material inputs, avoiding the social cost of attempting to economise on labour.

5) Conventional economic analysis tends to favour centralized production and distribution systems because of the perceived existence of economies of scale. The case for scale efficiency is disputed amongst neo-classical economists (cf. Nader et al., 1976; Adams, 1988), and has even fewer supporters among those with an ecological analysis. The narrow concept used in the analysis of scale efficiency is inadequate because of the neglect of environmental and social costs. Centralized systems are unsustainable in the long term. The new approach aims to decentralize production and marketing systems by facilitating closer connections between producers and consumers.

6) Markets are not competitive in any classical sense. The preconditions for a truly free market do not exist in the Canadian agricultural context.

5.3.2 An efficiency strategy: corporate greening

Corporate "greening" is now a significant movement and is manifested in the changing product lines of existing firms and in the appearance of new firms selling more environmentally benign products[36].

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36. Because business structures and practices are similar in different sectors of the economy, many change strategies can not be targeted specifically to agriculture. In the following sections, remarks on the

One agricultural example is the selling of organic foods through the traditional food distribution system. Historically, organic foods have been sold more through specialty and health food stores and by direct marketing (Geier and Vogtmann, 1984; Cook, 1988; Hay, 1988; Henning et al., 1990). Recent surveys in Europe, the USA and Canada have consistently shown that a substantial number of consumers (40-80%) are interested in buying organic foods on a regular basis, and that a significant percentage are willing to pay a premium, generally in the 15-30% range (Stoney, 1987; Baseline Market Research, 1988; Peter and Ghesquière, 1988; Jolly et al., 1989; Morgan and Barbour, 1989; Poncavage, 1989). This sector was ignored by the conventional food industry until very recently. Now all the major Canadian retail chains are selling some organic products, several major manufacturers are developing processed goods, and export markets are being expanded in Europe and the USA (cf. IFOAM, 1989). Many analysts believe that the best way to expand this sector is to distribute organic food through the conventional food system (cf. Hill, 1986a; Grégoire and Rocq, 1988; Boutet, 1989).

Such a development demonstrates both the strengths and weaknesses of efficiency strategies. Organic food production systems represent a signficant step in the direction of sustainability, not just in environmental terms, but also with regard to farm self-reliance and rural community sustenance. The presence of organic food in the conventional food distribution system increases accessibility and encourages organic food production. Without significant changes, however, to the organization and behaviour of large agribusiness firms, the characteristics that define

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potential impacts of different strategies are confined to agribusiness firms, although in many cases effects would be more far reaching.

sustainability (cf. Douglass, 1984; Table 51) are likely to be lost. For most agribusinesses, "consumer interest in organic foods is a market to be co-opted just like any other" (Bird, 1988). Thus, there is a danger that the involvement of the conventional food distribution and retail sectors will result in the commodification of organic food consistent with the commodification of other food products.

Organic food, by its nature and definition, however, is more difficult to commodify than conventional foodstuffs. This is in part indicated by some of the problems that have been emerging in the conventional distribution system (Table 62). Significant barriers to purchases and sales of organic foods have been identified in the meat processing, transportation, distribution and retail sectors. Many of these problems are related to inadequate supply, but others are due to the emphasis in organic production on localized production and distribution. Use of plant varieties and animal breeds will vary tremendously within and between regions to reflect the ecological realities of every farm. The producer's concern with food quality means that few are interested in harvesting their crop early to allow for lengthy periods of shipment. Moreover, certification standards do not permit the application of many of the post-harvest and processing treatments that permit products to be transported to central distribution points and then shipped over long distances to retail outlets. Philosophically, many producers are opposed to the kinds of food packaging used in the traditional food system, and to the energy inefficiency associated with long distribution lines. Many retailers have yet to realize that organic foods are a different kind of product and are having difficulties with product promotion. Some are reporting low sales

Table 62
Some problems with the distribution of organic foods in Canada

Sector	Problem
Slaughtering and meat processing	Few slaughter houses willing to handle small volumes of organic meats Difficulties ensuring the separation of organic from conventional meats in the slaughtering facility Uneven demand for organic meat cuts means some parts of animal are sold through conventional channels increasing costs of organic meat
Transport	Insufficient volume in many areas to arrange for regular, reliable transport Excessive costs because fees are discounted with volume Containers are often contaminated by previous shipments; farmers often have to provide own liners and do their own loading to ensure organic quality not compromised
Processing	Lack of on-farm or regional facilities in many areas Excessively expensive to supply facilities because producers are dispersed Difficulties ensuring the separation of organic products from conventional ones in the processing facility
Storage	Lack of on-farm or regional storage facilities Difficulties ensuring the separation of organic products from conventional ones in the storage facility
Distribution	Uneven dispersal of distributors (i.e., excessive competition in some areas, with monopolies in others) Centralized purchasing and distribution requirements of major national chains
Retail	Insufficient range of products available in a given outlet Unattractive packaging and display Difficulties differentiating organic from conventional fresh produce at the checkout counter, resulting in extra costs for keeping produce separate Separate organic sections sometimes operate under non-ideal temperature and humidity conditions

levels as a result[37]. Firms that specialize in the distribution and marketing of organic foods are having difficulties also, but these are related more to the absence of infrastructure commonly associated with an immature market (Hall et al., 1989; Canadian Organic Growers, 1990; Henning et al., 1990).

Other "greening" initiatives include Loblaw's diverse line of green products (cf. Kohl, 1990), Heinz's line of "dolphin-friendly" tuna products (Ramirez, 1990), restauranteurs' use of organic foods and their modifications to food packaging (cf. Menzies, 1990; Stewart, 1990), and the chemical industry's investment in developing bio-herbicides (cf. Watson, 1985).

Corporate greening does have a certain appeal as an efficiency transition strategy. It is reasonably easy for business to implement, and is an intial response to consumer desires to be involved in improving the environment. Governments see it as desirable because it does not require extensive intervention on their part. Many economists like this approach because it is consistent with their desire to employ market solutions to environmental problems (cf. Doern, 1990). A major weakness, however, of many of these greening initiatives is the absence of standards and verification procedures that identify both the degree of benefit to the environment, and that can guarantee the authenticity of the purchased item. Among environmentally friendly products, the organic food industry presently has the best developed verification system. It includes standards, inspections, and certification procedures. However, it still

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37. This was confirmed in a meeting in November 1989 with senior executives of the three major Québec food retailers.

lacks the support provided by legal recognition and enforcement by government. This situation will soon change, however, as three provinces are presently developing regulations to control the use of the term organic, and the federal government is being advised to act similarly (Ad hoc Committee on Natural and Organic Foods, 1990). Agribusiness and government have been under pressure to set standards for other "green" products (cf. Kohl, 1990; Marder, 1990), and Consumer and Corporate Affairs has just announced that it will regulate the advertising of "earth-friendly" products (Anon., 1990a). These developments will force firms to take a more comprehensive, long-term strategy to greening, involving not only products, but also packaging, transportation, pollution, waste management and worker safety. The UK super store Tesco has taken such an approach by demanding "cradle to grave" environmental accountability from suppliers, and by reducing its corporate energy consumption and waste generation (Goldstein, 1990).

Unfortunately, many companies have beem too quick to jump onto the greening bandwagon, developing products without sufficient understanding of environmental issues, or failing to carrying out sufficient research on the environmental impacts of the product. Examples include Proctor and Gamble's Enviropak for fabric softeners (Goldstein, 1990) and biodegradable plastic packaging (Riggle, 1990). When weighed against the problems outlined in the previous section, it is clear that corporate greening is at best only a stepping stone to more responsible programs.

5.3.3 Substitution strategies

5.3.3.1 Structures to confront corporate power

5.3.3.1.1 Marketing boards and coops

Marketing boards were created in Canada to confront the power of large agribusiness firms and to maintain a significant level of control over output and output prices by farmers. There are now over 100 agricultural marketing boards in existence in Canada, covering many sectors of agricultural production and representing a broad range of powers over the marketing of products. The greatest power is generally associated with supply management or exclusive marketing rights (Coffin, 1987), powers that not all boards have[38].

Cooperatives have also long been used to obtain more control for members over their economic situation. Agricultural cooperatives take many forms in Canada, from the giant prairie wheat pools, to small groups of farmers managing their resources cooperatively (cf. Gertler, 1981). They have, for a variety of reasons, experienced varying degrees of success in confronting corporate power. Cooperatives in the grain and dairy sectors have been more successful than those in meat and poultry processing (Coffin, 1987).

Part of the failure of marketing boards and cooperatives as presently managed is a result of their failure to address the root cause of corporate power. Most have attempted to create an equal or greater

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38. Lobbying by agribusiness, and the federal government's commitment to free trade, could erode the ability of boards to compete with major firms (Warnock, 1987; Pugh, 1989).

force operating on farmers' behalf, an approach consistent with a substitution strategy, rather than developing a comprehensive program to create a cooperative economy (a redesign approach). Creating marketing boards appears not to be a popular strategy for promoting sustainable agriculture, although several boards are supporting, or are being pressured to support, the marketing of organic products (cf. Crowley, 1989; Nimmo, 1989). Forming cooperatives may be a more viable strategy, particularly because the market for sustainable agriculture products is immature. Many small cooperative enterprises producing or distributing organic products are already in existence.

5.3.3.1.2 Matching corporate information power

One of the keys to agribusiness success is their control of information. Many of the most successful firms have developed their own sophisticated information collection and distribution systems that rival or exceed those of any public institutions (cf. Morgan, 1980 and Kneen, 1990). One response by activitists has been to establish grassroots information networks to counter the information power of agribusiness firms. The Pesticide Action Network (PAN) provides one of the most interesting and successful examples.

PAN is an international network of environmental and consumer organizations founded in 1982. Its highest profile project has been the "Dirty Dozen" campaign, launched in 1985, to eliminate 12 (updated to 13 in 1986) of the most dangerous pesticides (or pesticide groupings) from the international market place (cf. Gips, 1987). Although much work remains to be done, the project has been tremendously successful in convincing governments around the world to ban or severely restrict these pesticides (Griffith, 1989; Siedenburg, 1989).

The most effective weapon of the campaign has been access to information. Network participants monitor the production, marketing, distribution and use of pesticides in their respective countries, and share this information with other members of the network. This has permitted them to identify corporate activities in violation of international codes, to document and disseminate case information on harmful effects of pesticides on people and the environment, and to compare corporate activity and government responses in different parts of the world. An important tool for achieving this has been the "United Nations Consolidated List of Products Whose Consumption and/or Sale Have Been Banned, Withdrawn, Severely Restricted or Not Approved by Governments". Seventy-seven countries contribute to this list, which includes information on hazardous products and regulatory decisions. Pressure from groups around the world was critical to convince the UN of the need for such a project, especially in the face of stiff opposition from some industrialized countries and the corporate sector, who recognized early on the list's potential to facilitate change (Nic, 1989). The identification of unethical and dangerous corporate practices by PAN members has proved to be a powerful tool for convincing consumers and governments that such activities should not be permitted, and has resulted in considerable changes to corporate activity[39].

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39. For a revealing case study, see Epstein (1989) and Marquardt (1989a) regarding the changes forced on Velsicol Chemical Corporation, and the company's on-going battle to continue to produce Chlordane and Heptachlor.

The success of this approach in changing corporate activity is limited because information is often difficult to obtain (cf. Marquardt, 1989b), and because networks such as PAN have few resources and direct political influence in comparison to large corporations.

5.3.3.2 Consumer activism

Consumers have historically acted singly and in groups to effect changes in agribusiness practices. An example of each type of action is provided in this section. Ultimately, consumer power will best be tapped by the creation of organizational structures that coordinate their actions. This aspect will not be discussed here.

5.3.3.2.1 Selective purchasing

Consumers sometimes make purchases based on criteria other than price and traditional measures of quality. These decisions may be expressed in positive or negative terms. For example, the most recent Grocery Products Manufacturers of Canada survey identified a core group of 25% of consumers willing to go out of their way to make purchases based on environmental concerns. Eight of ten respondents would consider paying more for environmentally safe goods (cited in Strauss, 1990). Similar results have been reported in the USA (Goldstein, 1990). The corporate greening movement has been largely driven by consumer desires to purchase products friendly to the environment.

Consumers may also choose not to purchase certain products because they oppose activities of the company, or aspects of its product. Sucessful agribusiness boycotts have included the action against Nestlé to counter its infant formula selling techniques in the developing world (cf. Meeker-Lowry, 1988), and the boycott against Burger King to change its policy of purchasing Central American beef raised on cleared rainforest land (cf. Anon., 1989f). Boycotts, besides having direct effects on business policies, have indirect effects on consumer consciousness and may result in more purchases of products from companies deemed to be more socially responsible.

A lack of consumer information on corporate behaviour has been, in the past, a major obstacle to selective purchasing. Recently, however, several guides to environmentally and socially responsible purchasing have been produced to assist consumers in this effort (Elkington and Hailes, 1988; Will et al., 1988; Pollution Probe, 1989).

5.3.3.2.2 Ethical investment

Consumers are also making political statements with their investment decisions. The ethical investment movement began quietly in the late 1960s, but investment levels have increased dramatically in the past few years. The USA now has eight ethical mutual funds (assets of $1 billion) plus another $500 billion in pension fund money in ethically screened stocks, representing about 10% of all money passing through Wall Street. Canada has six ethical funds with $92 million in assets, less than 1% of the total mutual fund market (Eisenkraft, 1990).

The funds have performed well financially. Good Money's stock average in the USA has outperformed the Dow Jones Industrial Average (Meeker-Lowry, 1988). Canadian funds have consistently outperformed the

TSE benchmark index (Eisenkraft, 1990). Doubters, however, contend that success will be short-lived because the screening process restricts options for investors. Others are concerned that the funds represent only a partial strategy for effecting change, and that they distract investors from investing in truly alternative enterprises (Nicholson, 1987; Eisenkraft, 1990). The success of ethical funds may ultimately depend upon the creation of standards and monitoring procedures that authenticate the ethical nature of investment.

Disinvestment, the opposite side of the ethical investing coin, has also been a partially successful strategy for generating changes in business practices. The most notable example has been the South African disinvestment campaign (cf. Meeker-Lowry, 1988).

5.3.3.3 Changing the characteristics of and regulations governing the corporation

All significant agribusiness firms are corporations[40], a business form with several characteristics that make it popular: limited liability for shareholders and managers, legal personality (i.e., the corporation is treated as a "person"), easy transferability of ownership, continuity of existence, and concentration and specialization of management (cf. Sethi, 1977). These same characteristics present problems for the development of sustainable agriculture and will need to be changed. Convincing governments that such changes are necessary will require a well organized and lengthy campaign.

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40. For general historical perspectives on the corporation in Canada, see Levitt, 1970; Niosi, 1985; Carroll, 1986; Kierans and Stewart, 1988.

5.3.3.3.1 Legal changes to the status of the corporation

The North American corporation today bears little resemblance to its original form or purpose. Originally conceived as an instrument of public good, a series of legal modifications to the chartering and rules governing corporations changed the corporation into a vehicle for private profit and power (Mintz and Cohen, 1976; Nader et al., 1976; Kierans and Stewart, 1988). Several legal strategies have been proposed to return the corporation to its original purpose. In its original form, corporations (and, thus, agribusiness firms) are more likely to contribute to the development of a sustainable food and agriculture system.

Nader et al. (1976) have proposed that many of the original features of corporations be reinstated by changing the legal requirements of incorporation. Such regulations would require that the incorporation be for a fixed (but renewable) time period, that the corporation have a single purpose (i.e., concentration on a specific product or process), and that limitations be applied on size, activity, geographic area and permitted level of indebtedness. All these restrictions would likely make agribusiness firms more responsive to local and regional needs, a critical feature of sustainable systems.

Ultimately, the legal status of the corporation should be reconstituted in such a way that corporations are subject to the same kinds of constitutional provisions to which public bodies are subject regarding the rights of the person (Nader et al., 1976; Satin, 1987a). Alternatively, as Mintz and Cohen (1976) have suggested, the natural environment must be given the same legal rights of the person as the corporation in order to counter corporate power.

5.3.3.3.2 Shareholder control

Most shareholders have little control over the activities of the corporation in which they have ownership, but originally the shareholders' meeting was the control mechanism for corporate policy (Nader et al., 1976). Now, however, most corporations are run by a management autocracy that effectively appoints the board of directors (Kierans and Stewart, 1988). To restore control to shareholders, corporations should be required to distribute the annual profits to the shareholders in cash and stock dividends. If the corporation wishes to raise more money for its activities it must then persuade the shareholders to reinvest (Kierans and Stewart, 1988). Non-voting shares should also be abolished because they limit shareholder involvement (Francis, 1986; Kierans and Stewart, 1988).

For the board to be a real instrument of the shareholders requires a redesign of the board election process, and of the composition of the board, and its function (Nader et al., 1976; Francis, 1986). The board would have to have a defined function that clearly separates its responsibilities from that of management. Specific places on the board would be designated for shareholders, employees and the general public. The board would function as an internal auditor of the corporation and would require community and environmental impact assessments of management proposals (Nader et al., 1976). Such an empowered board would require complete information on all aspects of the corporation's activities, including finances, lawsuits, pollution, political activities, ownership of other firms, advertising, personnel, and occupational health and safety (Mintz and Cohen, 1976; Nader et al., 1976).

5.3.3.3.3 Restricting mergers and acquisitions

Although American governments have historically used several laws to restrict certain kinds of mergers and acquisitions (cf. Nader et al., 1976), Canada has only one significant legal instrument in place, the Competition Act (and affililated Competition Tribunal Act[41]) passed in 1986. The Act concentrates on industry or market competition, but the government believes that other concerns regarding corporate concentration will be addressed in the long-term by focussing on these particular aspects. The central objective of the legislation is to use competition as a vehicle for assuring efficient allocation of resources. "It is not the size of the firm that is the primary concern under the *Act*, but rather the use and abuse by a firm of its market power" (Goldman, 1988:490). It is not necessary for the government to prove that public detriment will result from a merger or acquisition, but rather that such an action will lessen competition substantially (Goldman, 1988).

The effectiveness of this legislation has yet to be fully tested. Because the business community had a significant impact on the development of the legislation, some are not convinced that it will effectively lessen the degree of competition (cf. Stanbury, 1988). Others feel that the Competition Bureau, charged with administering the legislation, does not have clear evaluative guidelines and standards (Corcoran, 1989; McKenna, 1990),

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41. Note that the Tribunal was recently ruled unconstitutional by the Québec Superior Court. This ruling has not challenged the federal government's authority over regulating competition, but rather the powers of the Tribunal itself as it relates to guaranteeing independence and impartiality in its investigations and rulings (McKenna, 1990).

lacks the human and financial resources to respond to the latest merger and acquisiton wave, and is doing too much backroom negotiating with companies, rather than using the Tribunal (Smith, 1989). The action against NutraSweet, presently before the Tribunal, is widely seen as a significant test of the legislation and the will of the Bureau's leadership (Fagan, 1990).

Several analysts have suggested more proactive legislation that actually forbids the merging of corporations above a particular size (cf. Satin, 1987b), or those having a dominant influence within a market (cf. Nader et al., 1976). The toughest American anti-takeover legislation was recently passed in Pennsylvania. The intent is to prevent speculative takeovers by requiring that significant investors forfeit profits if they sell their shares within two years of a challenge to management (Pound, 1989). The law also requires boards to base decisions, not only on shareholders' concerns, but also on those of employees, suppliers, and the general community[42] (Goel, 1990). Detractors claim that the bill will contribute to the entrenchment of incompetent, complacent management and distort market forces (Pound, 1989; Anon., 1990b; Corcoran, 1990; Goel, 1990). Over 25 other states have enacted similar, but weaker, legislation (Pound, 1989; Anon., 1990b).

Legislation to control mergers and acquisitions is likely to only partially succeed, or to generate new negative side effects because it does not address the root cause of merger activity. As a single strategy, such restrictions are unlikely to promote sustainability, but in concert

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42. Business ethicists are claiming that such a definition of the firm's responsibilities is critical for the creation of an environment in which ethical business practices can be employed (cf. Andrews, 1989a; Donaldson, 1989).

with other initiatives they may contribute significantly to a reduction in oligopolistic influence over the food sector.

5.3.3.3.4 Tax revisions

There is little doubt that the current North American tax regime encourages corporate concentration[43] (cf. Nader et al., 1976; Francis, 1986; McQuaig, 1987; Wolfson, 1988; Ward et al., 1989). The specific elements that have created this situation, and solutions to alleviate the associated problems, however, are less clear. Changes have been proposed in two general areas: corporate tax structure and individual taxation with an emphasis on increasing taxes for high-income groups. The implications for sustainable agriculture are not entirely clear as little work has been done in this area, but these kinds of changes would likely constrain the growth of agribusiness firms.

Kierans and Stewart (1988) proposed five tax changes to control the corporation: a tax on business costs, particularly non-renewable resource costs, eliminating the unequal treatment of capital gains (see also McQuaig, 1987), replacing the federal sales tax with a value added tax, removing the corporate tax, and stopping the deduction of takeover costs (see also Francis, 1986: Blenkarn, 1988). Wolfson (1988) has argued that

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43. Note that some analysts feel that government tariffs and foreign ownership restrictions are as important as taxation issues in promoting corporate concentration (cf. Francis, 1986). Others, in contrast, feel that Canadianizing our capital markets is a critical strategy for gaining control over corporate activity (cf. Kierans and Stewart, 1988). None of these analyses have been done in the context of sustainable agriculture systems, which are more local and regional in nature than conventional systems. Until such analyses are performed it is difficult to identify the validity of these contrasting views as they affect agricultural enterprises.

tax code revisions to discourage firms from continuously substituting capital for other resources are the most critical. The tax regime, he has argued, provides too many incentives for investing in capital equipment and structures, and in resource exploration and development. These incentives are a major driving force for excessive firm size and profitability, and ultimately corporate concentration. Many of these revisions were proposed by the federal government's Carter Commission in 1967, but little of the report was ever adopted because of massive opposition from the business community (McQuaig, 1987).

Annual wealth taxes, and inheritance, accession or estate duties have also been proposed as vehicles to transfer wealth away from the wealthiest families (Francis, 1986; McQuaig, 1987; Brander, 1988). Of these, one of the most interesting proposals evolved from the discussion over the Carter Commission report. A five-year evaluation rule was suggested by which shareholders would be taxed every five years on the increased value of their stock (excepting small businesses). The effect would be to increase the movement of stock, as holders would likely have to sell some stock to pay the tax bill. Analysts believed that this would result in a reduced level of ownership concentration (McQuaig, 1987). It was never adopted, although several European countries have taxes of this nature (McQuaig, 1987; Kierans and Stewart, 1988).

5.3.3.3.5 Increasing liability

Originally, shareholders and directors were totally liable for the activities of their corporation, but over the years, in order to protect investors in the hope of attracting more money, this liability has been reduced, or indemnification insurance purchased. Unfortunately, this has helped to foster a culture of irresponsibility within many corporations (Nader et al., 1976; Kierans and Stewart, 1988). To encourage responsible action, it seems reasonable that directors and shareholders be liable for the negative financial, environmental, health and social actions of their corporation (Nader et al., 1976; Francis, 1986; Kierans and Stewart, 1988). The Environmental Protection Act now contains some provisions that permit the prosecution of corporate directors and managers.

5.3.3.4 Broadening the ownership base

Two of the most popular recent proposals to confront ownership concentration are the Universal Stock Ownership Plan (USOP) and the Employee Stock Ownership Plan (ESOP). Although not developed to promote sustainable agriculture, they do contain features that could, in concert with other substitution strategies, decentralize control and potentially make corporations more responsive to local concerns.

Developed by an American lawyer (cf. Speiser, 1986), the USOP is designed to provide the 94% of Americans who do not hold stock with ownership in the USA's largest 2000 corporations as part of a strategy of healing economic divisions. The plan would require federal legislation forcing these corporations to issue their new stock to the 94%, instead of financing new initiatives by means of internal savings and debt. The legislation would also provide for loan guarantees to permit individuals to buy stock. The money would be owed by a USOP fund (a type of mutual fund), not by the individual. Companies would be required to pay out earnings in dividends which would first go directly for loan repayment, and then later to individuals. Speiser (1986) has claimed that the plan is not utopic because it does not require a change in human nature and it reflects the realities of corporate finance. It uses the same system of long-term credit acquisition as is presently used, and government loan guarantees of a similar nature have been provided in the past (Morehouse, 1986; Speiser, 1986). It also does not require redistribution of current assets as this would be politically impossible in the USA (Morehouse, 1986). Many of the details of the proposal have still to be examined (cf. Speiser, 1988). Over a 20-year transition period, ownership of productive assets by the 94% would shift from virtually nothing to about 50% (Morehouse, 1986). A similar proposal was seriously discussed by the recently defunct Social Democratic Party in the UK (Morehouse, 1986; Speiser, 1986).

ESOPs are a more limited application of this concept, involving the distribution of shares to workers through an employee-owned pension trust. The effect is to share profits with employees, and often to increase employee identification with the corporation. Tax changes in the UK and the USA have made ESOPs more financially attractive to companies (Ekins, 1986b). They do not result, however, in the widespread distribution of ownership that is associated with the USOP proposal. Neither this nor the USOP proposal address the need for more democratic management (Lutz and Lux, 1979).

Broadening ownership does not, in itself, guarantee the dominance of a sustainable agriculture perspective within agribusiness firms, but may create a more receptive environment in which this perspective can be heard.

5.3.4 Redesign strategies

Some specific medium-term objectives that flow from the goals for a sustainable food system are presented in Appendix 13. These provide examples of targets to which agribusiness firms (and other food system players) would commit themselves. They also reflect a change in emphasis from competition, which dominates current food system objectives, to cooperation which is integral to achieving sustainable agriculture goals. Many of the strategies outlined above could help to create an environment in which such medium-term objectives could be adopted by firms, but on their own they would not likely produce the changes necessary to create sustainable systems. Ultimately, transition is dependent on changing the rules by which agribusiness measures success, namely calculations of financial benefit. This redesign of the market is likely, however, to be the most difficult social choice mechanism of all to redesign, because the market presently reflects our society's most entrenched commitment to economic rationality[44] (Dryzek, 1987).

Two principal redesign strategies are discussed below. One is the development of alternative business forms, such as community land trusts

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44. Dryzek (1987) also argues that the economic values (economic rationality) that currently dominate our institutions must be replaced by ecological ones (ecological rationality).

(CLT), community supported agriculture (CSA) and local exchange trading systems (LETS), that are consistent with both sustainability goals and the medium term ojectives outlined in Appendix 13. These intiatives are characterized by a delinking from the global economy, an inverting of traditional business infrastructures, and the revitalization of local resources and knowledge (Sachs, 1986). The second strategy is the redesign of economic concepts to support sustainability, i.e., the development of ecological economics[45]. The key requirement of such an effort is to retain those aspects of the market that create real (including ecological) efficiencies as well as making economically operational the ecological realities of human activity (Paehlke, 1989).

5.3.4.1 Alternative enterprise forms

The community land trust is an example of an alternative enterprise reflecting redesign concepts and has been discussed in some detail in Section 5.1.3.3.2. 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

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45. Note that this approach represents an expansion upon that being proposed by business ethicists. The ethical perspective focuses primarily on how ethics must be incorporated into management (cf. Andrews, 1989b; Donaldson, 1989)

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). The land trust corporation is controlled by the community.

Community-supported agriculture has also been presented earlier (Sections 1.5 and 2.5). CSAs are structured so that farmers and consumers work cooperatively to meet mutual objectives. Consumers pay set fees and develop work schedules at the beginning of the season, and then collect their produce on a regular basis throughout the growing season. Decisions on what will be produced and on what schedule are taken cooperatively. Consumers are guaranteed access to fresh, nutritious food at prices often lower than those found in the conventional distribution system. Farmers are much better able to plan for the season, reduce risks and be assured of minimal cash flow problems.

Local exchange trading systems (LETS) are a second example of the kind of alternative enterprises that have sprung up in the past 10 years. "LETS is an economic network of members who trade goods and services with each other and track their transactions either by computer or in writing." (Meeker-Lowry, 1988:160-161). An effective LETS operated on Vancouver Island for much of the past decade. Members used "green" dollars in the exchange process and, in this way, created a local currency that had no value outside the community. The two principal disadvantages of a national currency, its export outside the community, and its vulnerability to international financial markets, were avoided. With this activity, the local currency keeps the flow of money within the community, prevents speculation and trading in money (the means of exchange) itself, and ensures that all those who have either goods or services to offer to the community can participate in the local marketplace (Ekins, 1986c). This particular LETS also had a significant impact on the participants' sense of community. The system does not rely on direct barter, as participants can receive a good or service from person A and then "repay" that good or service to person B. Participants value each other for their skills and talents, as opposed to the commodities they produce (Meeker-Lowry, 1988).

5.3.4.2 Principles of an ecological economics

Although the basic concepts of ecological economics are not new (cf. Martinez-Allier, 1987; Costanza, 1989), they have been marginalized by the economics profession and by business for several centuries. There has been a resurgence of interest in ecological economics in the past two decades, and the foundations of such a discipline are now fairly well established. The operational economic tools, however, are not yet fully developed and will only evolve with further thinking and practice. The essential concepts (Schumacher, 1973) are presented below.

1. Non-renewable resources are treated differently from renewable ones (referred to as the economics of permanence).

2. Cheap resources are substituted for expensive ones.

3. Those resources that are irreplaceable are priced very dearly.

4. Value is measured in socio-cultural, political and ethical ways.

5. Markets reflect that individual decisions are rarely made with full information.

6. Environmental, socio-economic and cultural impacts are internalized.

7. Consumption is minimized, goods and services are produced to meet needs, not wants (cf. Hill, 1982, 1986b for discussions of the distinction).

8. Efficiency is defined through maximizing the use of what is in the greatest supply (often labour).

9. The economy is viewed as a whole with thousands of sub-economies.

10. Creative activity is valued as more important than goods produced.

11. Production from local resources for local needs is the most important kind of production.

12. The focus of economic analysis is on the normative (where we want to go for the long-term) as opposed to the positive.

The challenge is to operaticnalize these concepts so that they are usable on a daily basis. Robertson (1987) has outlined some of the key areas requiring further work, at both the level of the firm, and in local, regional and national accounting and analysis:

1. Reform of resource and energy accounting (some progress has been make in this area, cf. Henderson, 1981; Leipert, 1986).

2. Ways to give economic value to efforts to establish self-reliance.

3. Measures of the benefits of social investment by public bodies, the corporation and the individual.

4. Techniques for shifting tax burden away from work and on to energy and resource use, and pollution, damage and nuisance (cf. Fleming, 1987; Postel, 1987; and Weinschenck, 1987 for some thoughts on this).

5. Economic measures of optimal nutrition and health.

6. Economic measures of voluntary contribution to community.

7. Elaboration of economic conversion strategies for different sectors (See Section 2.0 for agriculture).

The debate is now underway within the community of economists and other interested professions regarding how economic tools can be modified to suit these concepts (cf. Lutz and Lux, 1979 for some examples of detailed mathematical modifications to standard economic theory). It is likely to be a lengthy discussion that will ultimately challenge the basic assumptions on which our economy and agribusiness practices rest. Eventually, changes could lead to the removal of food from the commodification process. This would be an acknowledgement that the equitable distribution of such a basic requirement can not adequately be determined by its value as a commodity in the market place.

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 dealt 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 research 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 particular, 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 paragovernmental institutions

<u>Efficiency strategies</u>

1. Modify programs that limit agricultural diversification
2. Modify programs that specifically restrain sustainable agriculture

<u>Substition strategies</u>

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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Appendix 1

Some psychological factors that can affect a scientist's values and investigative procedures and a presentation of how I have examined myself in an attempt to ensure that my values and emotions have a constructive influence on the investigation

Knowledge is a result of the dynamic interaction between a number of factors, including the values embedded in our investigative procedures. These values may be a product of the knower's experiences from earlier stages in their psychological development, particularly by their responses to unintentional emotional oppression by parents and other authority figures (Jackins, 1965; Rowan, 1983). This oppression produces disempowerment which, in turn, attracts individuals to external symbols of power and approaches to problem solving that are often ecologically and socially oppressive; in a sense, they compensate for that earlier oppression (Hill, 1986b). It is this compensatory activity that often produces a destructive relationship with our environment. "Functioning" humans are viewed as being actually benign, and in a fully aware, empowered state, are at ease in a supportive environment, and seek benign solutions to problems (Maslow, 1966). Some examples are provided in Table A1 of how attitudes to agriculture are shaped.

To be a truly effective investigator, Maslow (1966) concluded that the scientist must create an anxiety-free state within him/herself in order to see the real world, as opposed to the investigator's own neuroses. Different counseling approaches have been proposed for investigators as a means for regularly assessing the extent to which one's values or neuroses are playing a constructive or destructive role in the investigation.

Table A1
Examples of how attitudes in agriculture are shaped by psychological factors
(Hill, unpublished)

Some Messages We Receive as Children	Some Resulting Feelings and Conclusions	Some Possible Outcomes
You're not good enough / not acceptable as you are	Things have to be / appear to be perfect to be acceptable / "good" (olympic standard)	Concern for appearance <u>vs</u> substance, e.g., cosmetic quality, weed / insect-free world Maximization <u>vs</u> optimization
Do what I say... immediately ... or you'll be punished	Powerless, a victim Success is associated with controlling things Control comes from outside Effectiveness is indicated by quick results	Attraction to "compensatory" symbols of power, e.g., pesticides, growth regulators, irradiation. Organization of world to permit easy control, e.g., by simplification, specialization (e.g., monoculture)
You're a "pest" and have to be controlled	I'm an alien - not really part of nature Earth is not really home - it has to be conquered	Identification and repression of "enemies" that interfere with the above model. Lack of long-term, gradual, indirect approaches to solving problems
You've had enough (love, attention, food, etc.)	I need <u>(compensatory wants)</u> to be be happy	Settling for less of what you really need (love, nourishment...) while compensating with subsitutes (junk food, large farms, consumer society)
You can't do it right or on your own	Disempowered I always need help	Impotence, procrastination, hopeless, helpless, lack of creativity and independence, settling for conventional agricultural models

During the course of this project, I have identified a number of distresses that at various points of the investigation clouded my ability to see the subject matter clearly. Through the assistance of colleagues and by the use of reevaluation counseling (Jackins, 1965), I have been able to identify and remove these distresses. I have kept a diary and provide here brief summaries of the most important perceptions.

November, 1987. A number of friends and colleagues, when reviewing my work, have commented on the negative tone I use when writing about the current state of agricultural institutions. They detect an "enemy" orientation in my analysis. I admit that I get angry when I see and read about some of the activities in our agricultural institutions. I have been learning that most people are well-intentioned and are operating to the best of their ability, with the information they have available to them.

February, 1988. My self-esteem is still too closely connected to what I know. This gets in the way of me listening to what others think and feel about a subject. I am learning to listen to different views without feeling a need to disagree.

May, 1988. I have caught myself rejecting arguments in documents that counter a view I hold. I have to incorporate contradictory evidence into my analysis rather than reject it as an aberation or outlier.

June, 1988. Stuart has seen that I am afraid to go out and talk to groups. I fear having my ideas rejected. This is a strong pattern from childhood, when I approached every trip with trepidation. This will seriously restrict my ability to collect information. Acknowledging this fear is a big help.

July, 1988. I'm getting better at accepting information and filtering it later. My earlier tendency was to not even take it in if I was feeling saturated. Now I absorb it, place it somewhere I can retrieve it, and then sift through it later. I must not reject ideas and data because I'm being distracted by other events.

July, 1988. While revising the governmental barriers paper I was tempted to leave in place, because it strengthened my argument, information that would then be taken out of context . I must not do this. Context is critical to every piece of information. If I fail with my contextual analysis the whole project is weakened.

August, 1988. I watched the video "No Limits for Women". It made me realize that I still have many fears to overcome. I'm not going to fear anymore. I am loved. I don't need to worry about other people's love for me. I must have no fears about this thesis, must do everything I want to do, but balance this with taking care of myself so that I don't burnout.

August, 1988. I caught myself being negative about a reviewer's comments on our paper about agricultural credit. What triggers this? Some of the comments were irrelevant, so I got annoyed about all of them, including the substantive ones. I need to constantly remind myself to use contradiction to my advantage.

January, 1989. I realize that I'm getting closer to "non-attachment". I have a distance from the thesis now. The experience has been so rewarding that I'm not concerned about it passing. I'm also learning to give up my favourite language. I have caught myself in the past getting defensive about criticisms of things I write. I use jargon too much.

March, 1989. I'm not thinking about the future much. I'm not concerned about what will happen next.

April, 1989. I'm too close to burning out. I promised myself I wouldn't allow myself to get into this situation again. This is a contradiction of the idea of "non-attachment", feeling like if I don't do it, it won't get done. This implies a certain arrogance. I'm trying to be humble.

July, 1989. A great vacation. I feel more comfortable with paradox. I look less and less for direct connections between things. I want to be anonymous in my work. I'm understanding that phrase "less is more". I feel like I'm living it.

September, 1989. Being apart from Jennifer is very good for me. I'm realizing all the fears and assumptions I have about our relationship. This is making me acknowledge any fears I have about my relationships with others. I don't have to take on anybody's distress. I am learning to be much more emotionally supportive of others because I'm not feeling distressed about myself. I feel that I have a much greater capacity for support.

Appendix 2
Example of a document summary form

Author / ed. Ted Manning
Title: Soil conservation: the barriers to a comprehensive response
In: Prairie Forum
Ed. Year: 1988 (spring)
Publ./Jour./Conf.
Pages: 99-121

<u>Assessment:</u>

Popular / Academic / Institutional
Primary research / essay / synthesis / policy
Type of analysis: criticism / ~~strategies~~ / visions / institutional policy
Institutional affiliation: Governmental, Scientific
Discipline: Multidisciplinary
Recognition of disciplinary limitations: Strong -- Mid -- Weak
Awareness of new paradigms in field: Strong -- Mid -- Weak
Critic / supporter Internal / external
Activist / Academic / Business / Farmer / Institutional employee /
Bureaucrat
Biases / Assumptions / Explicit / Latent:
Heavy reliance on quantitative analysis as foundation for decision-making, feels that better data = better solutions
Political analysis: Within mainstream
Perception of sustainable agriculture: Focus on land use side
How holistic is analysis: Medium - sees some ecological connections
Agroecological paradigm: Some elements apparent

Levels of analysis: All, but emphasis on regional + national
Assessment of institutional reality: Sees limitations of short term policy
Short / Medium / Long term
Quality comments: Respected researcher/administrator. Very good conclusions given institutional setting. Useful discussion of political barriers. Consistent with preliminary patterns taken from other observations
Key observations:
See notes

Appendix 3
Basic questions asked of reviewers
(modifications made for each institutional area)

<u>Key questions on which to comment:</u>

1. What is your overall impression of the paper?
2. Which conclusions strike you as weak and why?

   Which conclusions strike you as strong and why?
3. Which conclusions do not seem plausible and why?
4. What evidence negates or contradicts these conclusions?
5. Can you identify other sources of evidence to confirm these conclusions?
6. What are other possible explanations?
7. What sources of data have been missed (documents, interviews, etc.)?
8. What are missing factors in the explanations?
9. Can you identify some exceptions that are not explained by the conclusions?
10. Do you see any illogical chains of evidence or conclusion?

Appendix 4

Reviewer contact summary form

Name of contact: Dr. Gordon Neish

Personal data

Institutional affiliation: Agriculture Canada

Discipline: Marine biology

Recognition of disciplinary limitations: Strong -- Mid -- Weak

Awareness of new paradigms in field: Strong -- Mid -- Weak

Critic / supporter **Internal / external**

Activist / Academic / Business / Farmer / Institutional employee / Bureaucrat

Biases / Assumptions / Explicit / Latent:

Has agroecological assumptions, tempered by perceptions of institutional realities

Political analysis: Probably Liberal

Perception of sustainable agriculture: quite good - leaders in Canada

How holistic is analysis: good

Appendix 5

Data quality assessments from interviews

Interviewee: Dr. J P. Madden

Date: 2/2/89

Place of interview Macdonald College (Madden speaking here)

Background of interviewee Ag. Econ. professor;
Manager of USDA LISA program

Interview data:

Strong	Mid	Weak
Collected later or after much confirming contact		Collected early
Seen in literature, interviews and workshops (many different disciplines)	Seen in diverse literature	Seen in limited diversity of literature
Interviewer is trusted	Just met, but was open, provided personal information. Sees me as an ally	Not trusted
Reported or seen firsthand		Heard secondhand
Volunteered information		Prompted info
Respondent alone with interviewer		Respondent in presence of others who hold different views

Appendix 6

Brief summaries of workshop procedures

(see also Table 16)

1. Lennoxville, QC: Conversion to sustainable agriculture

Very preliminary results of the study were presented orally to a group of extension agents from PEI. This was a very interactive session in which participants constantly posed questions or offered confirming or disconfirming comments. The session was recorded on videocassette.

2. Kemptville, ON: Political barriers to sustainable agriculture

This workshop was a subset of a larger workshop on taking action to create an organic food system for Canada. Six participants worked with me to identify existing regulatory barriers to farmers wishing to convert to sustainable agriculture. The group then proposed solutions for overcoming these barriers. All ideas were recorded.

3. Winnipeg, MB: Linking producers to consumers for sustainability

Participants were provided with an overview of issues affecting the creation of a sustainable food system in Canada. They were then asked to record their thoughts on five questions:

What are the main problems farmers face?

What are the main "food system problems" consumers face?

What are the ways consumers can be allies to farmers?

What are the ways farmers can be allies to consumers?

How could a farmer-consumer association help these groups to be better allies to one another?

4. Orangeville, ON: Strategies to change the food system

Participants were presented with an oral overview of preliminary findings in the study. This was followed by a discussion period in which participants identified the strength and weaknesses of the presentation and the issues presented. Participants then recorded their thoughts on a form answering three questions:

What are the most promising strategies for changing our food and agriculture system? Why?

What are the least promising strategies for changing the system? Why?

What is the role of government in promoting change in the food and agriculture system?

5. Ste-Hyacinthe, QC: Research needs in sustainable agriculture

Workshops were held as part of a large conference on research needs. Participants were divided into five sessions: fruit production, vegetable production, meat production, cereal production, dairy production. In each session, organic producers briefly presented their ideas on research needs as a way of generating discussion. Following this, a wide-ranging discussion of needs were presented and then prioritized by the participants. Conclusions were recorded on cassette and summarized.

6. Minneapolis, MN: Development of reciprocity agreements between organic certification agencies

Approximately 50 individuals participated in this facilitated workshop organized to explore the need for reciprocity agreements between organic certification agencies. Groups of 12-15 were created and given a mandate to discuss first the advantages and disadvantages of reciprocity agreements. When a consensus emerged that reciprocity agreements were necessary, groups were asked to discuss how obstacles to such agreements could be overcome. The whole session was recorded and a written summary distributed.

7. Williamstown, MA: Institutional barriers to adoption of sustainable agriculture

Participants were asked 4 questions in a brainstorming style participatory workshop. Ideas were recoreded on a blackboard and served as a record of discussion and as a source of further inspiration. The four questions were:

What do institutions do that gets in the way of the transition?

What can be done to overcome these barriers?

What is presently happening that needs supporting?

What should be done to support these current initiatives?

8. Ste-Anne de Bellevue, QC: Scientific barriers to multidisciplinary research

Participants were asked four questions. The responses were recorded on a blackboard. Several participants recorded their thoughts on paper and submitted them at the end of the workshop. The questions were:

What is the ideal scientist reward system to support long-term multidisciplinary research?

What is the ideal peer review system to support long-term multidisciplinary research?

What is the ideal funding program to support long-term multidisciplinary research?

What is the ideal organizational structure to support long-term multidisciplinary research?

Appendix 7

Preliminary themes: governmental restraining forces (barriers)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence
1. Absence of clear government goals	RTG1 2/88	Anecdotal	Jackson & Atkinson, 1980; RevFiG3
2. Absence of participatory goal setting process	RTG2 2/88	OPIRG, 1984	Barber,1984; Friedmann, 1981; RevFiG4
3. Analytical tools have become goals	RTG3 2/88	Brooks, 1986 Madden, 1986a	Center for Philosophy and Public Policy, 1985; Brown, 1987; RevFiG5,7,10,18
4. Agricultural goals and policies evolved from crisis, compromise and non -agricultural objectives	RTG4 2/88	Warnock, 1984 Skogstad, 1987 Phidd, 1979	Perreault, 1987; Forbes, 1985; Veeman & Veeman, 1976; RevFIG6,19
5. Farm organizations have a profound influence on agricultural policy	RTG5 3/88	Forbes, 1985 Skogstad, 1987	

Code: R=Restraining; T=Theme, G=Government; Rev=Reviewer; Fi=Confirming comment

Appendix 7 (cont.)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence
6. Bureaucrats have major responsibility for policy	RTG6 3/88	Chandler & Chandler, 1979; Jackson & Atkinson, 1980	Campbell & Szablowski, 1979; Kirby et al., 1979; Schrecker, 1984; RevFiG9,11
7. Difficult for central bureacracies to respond to local and regional needs	RTG7 3/88	Nowland, 1987 Sim, 1988	Lok, 1984; Dryzek, 1987; W.Or88.G30; RevFiG20
8. BNA has produced uncoordinated activity and duplication of effort	RTG8 3/88	Skogstad, 1987	Coffin, 1988; Manning, 1988
9. Absence of sense of mission amongst Agriculture Canada staff	RTG9 3/88	Previous work experience	Wilde, 1984; Beaubien, 1986; Plumptre, 1988; Jabes & Zussman, 1988; RevFiG8
10. Poor internal communication and information management	RTG10 4/88	Porritt, 1985	Kirby et al., 1977; Forbes, 1985; Manning, 1988 Jackson, 1988; W.Wi89.G11; W.Wg88.G17

Code: R=Restraining; T=Theme, G=Government; W=Workshop; Rev=Reviewer; Fi=Confirming comment

Appendix 7 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence
11. Ag.Can. goals different from SA goals	RTG11 4/88	Cornucopia Project, 1981; Hill, 1982; Dahlberg, 1985	Ag. Can. 1977,1981,1986,1987b, 1989a; W.Wg88.G17; RevFiG1,13,17
12. Not usually a rational goal setting process	RTG12 4/88	Jackson & Atkinson, 1980	Costello, 1970; Hartle, 1976
13. Several jurisdictions opposed to SA or specifically to organic farming	RTG13 4/88	Anecdotal	I.Fi88.G31; I.Ma89.G25; I.Sa89.G32; I.Cd88.G39; I.Cd88.G47; W.Or88.G28,31; RevFiG12,14
14. No real coordination in decision making	RTG14 4/88	Doern, 1972; Campbell & Szablowski, 1979; Chandler & Chandler, 1979; Jackson & Atkinson, 1980	Forbes, 1985
15. Legislature provides framework for agricultural legislation, leaves details to bureaucracy	RTG15 4/88	Jackson & Atkinson, 1980; Webb, 1987; Kirby et al., 1977; Chandler & Chandler, 1979	RevFiG15

Code: R=Restraining; T=Theme, G=Government; W=Workshop; I=Interview; Rev=Reviewer; Fi=Confirming comment

Appendix 7 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence
16. Most marketing boards do not have organic distribution channels	RTG16 5/88	W.Ke88.G1,G2,G3,G4, G7,G8; I.Sc88.G8; I.Fi88.G8	I.Mo89.G9; I.Ze88.G11
17. Labelling regulations are sometimes difficult for organic processors and retailers to follow	RTG17 5/88	I.Cl88.G4; W.Sh88.G20	I.Co88.G4; I.Ki89.G23; I.Sw89.G22 Henning et al., 1990
18. Some organic producers have difficulty obtaining credit	RTG18 5/88	I.Sk87.G48; W.Ke88.G10	W.Le88.G10; I.Br88.G5 RevFiG27 Henning et al., 1990
19. Some sanitation and animal health regulations contravene ideal organic certification standards	RTG19 5/88	W.Ke88.G5; I.Cl88.G19	I.Sc88.G19; I.Ki89.G19; I.Re88.G21
20. Some organic farmers have trouble obtailing crop insurance	RTG20 5/88	W.Ke88.G9	I.Br88.G2 Henning et al., 1990

Code: R=Restraining; T=Theme, G=Government; W=Workshop; Rev=Reviewer; Fi=Confirming comments; I=Interview

Appendix 7 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence
21. Grading criteria discourage sustainable practices	RTG21 5/88	W.Ke88.G6	Riccini and Brunt, 1987; Pimentel et al., 1977; Feenstra, 1988; Rosenfeld, 1990; I.Sc88.G10; RevFiG2
22. Production subsidies for crops and livestock impede farm diversification	RTG22 5/88	Bond et al., 1986; Fleming, 1987; MacRae, 1987; Postel, 1987	
23. Canada Wheat Board quotas impede farm diversification	RTG23 5/88	Senate of Canada, 1984; Nowland, 1987; Veeman, 1987	
24. Stabilization programs, price and income supports impede farm diversification	RTG24 5/88	Pidgeon, 1984; Gilson, 1987; Bond et al., 1986; Veeman, 1987;	Economic Council of Canada, 1988; I.Ma89.G24; National Academy of Sciences, 1989
25. Transportation programs impede farm diversification	RTG25 5/88	Gilson, 1987; Veeman, 1987; Senate of Canada, 1984; Nowland, 1987	Economic Council of Canada, 1988; Carmichael & Macmillan, 1988;

Code: R=Restraining; T=Theme, G=Government; W=Workshop; I=Interview; Rev=Reviewer; Fi=Confirming comments

Appendix 7 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence
26. Crop insurance programs impede farm diversification	RTG26 5/88	Pidgeon, 1984; Gilson, 1987; Veeman, 1987; Conservation Council of Ontario, 1986	
27. Ontario Drainage Act and municipal taxation impede farm diversification	RTG27 5/88	Conservation Council of Ontario, 1986; Gilson, 1987	
28. Federal fertilizer Act prevents registration of alternative products	RTG28 5/88	Anecdotal	RevFIG28
29. Government does not provide full information on food production practices to consumers	RTG29 6/88	Hall, 1974; Warnock, 1978; Pim, 1986	I.Co88.G7; W.Or88.G26; RevFIG33
30. SA practitioners may not meet eligibility criteria for subsidy programs	RTG30 8/88	I.Ze88.G12; I.An88.G12;	

Code: R=Restraining; T=Theme, G=Government; W=Workshop; I=Interview; Rev=Reviewer; FI=Confirming comment

Appendix 7 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence
31. SA practitioners may not meet eligibility criteria for business or organizational development programs	RTG31 8/88	I.An88.G16; I.Kl88.G16	
32. Many existing financing programs have room for a specific SA financing mechanism	RTG32 8/88	Belden et al., 1980; DeMarco, 1987	
33. Many existing taxation programs could include a specific taxation mechanism to support SA	RTG33 8/88	Costanza, 1987; Fleming, 1987; Postel, 1987; Weinschenk, 1987	
34. Many jurisdictions have created or could create legislative or regulatory vehicles to support organic certification	RTG34 8/88	Theriault, 1988; Peter & Ghesquiere, 1988	CSPI, 1989 Young & Schwenk, 1989
35. Research programs limit our understanding of SA	RTG35 8/88	Section 5.2	I.Cd88.G40,46

Code: R=Restraining; T=Theme, G=Government; W=Workshop; I=Interview; Rev=Reviewer; Fi=Confirming comments

Appendix 8

Modifications to preliminary themes: governmental restraining forces (barriers)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and Date	Used for which case?
1 Absence of clear government goals (RTG1)	Clear implicit goals of productivity and efficiency as defined neoclassically	Agriculture Canada, 1981; SCC, 1979; Kneen, 1983; Georgescu-Roegen, 1971; RevTrG61	Contradictory explicit goals but clear implicit ones	RTG1.1 4/88	RCG1
2. Absence of participatory goal setting process (RTG2)					RCG1
3. Analytical tools have become goals (RTG3)	Ag. Can. uses tools to choose between apparently irreconcilable options	Ag. Can. 1981;1986;1987b; 1989a; Weinberg, 1972; Hammond et al, 1983: RevTrG75	Information collected lacks appropriate paradigm	RTG3.1 4/88	RCG2
4. Agricultural goals and policies evolved from crisis, compromise and non-agricultural objectives (RTG4)					RCG1
5. Farm organizations have profound influence on agricultural policy (RTG5)	1. Not all groups have access 2. Well-established groups get more favourable response 3. Only insignificant issues 4. Commodity groups becoming more influential 5. Groups with few resources may have good relations with junior and middle management	1. Chandler & Chandler, 1979; Peoples Food Commission, 1980 2. Campbell & Szablowski, 1979; Dryzek, 1987 3 Miller, 1985b Coffin, 1988 4. I.Cd88.G36 5. Pross, 1986; Chandler & Chandler, 1979 I.Cd88.G38	Well-organized groups providing information to government have access. Different groups have access at different levels.	RTG5.1 9/88	RCG3

Code: R=Restraining; T=Theme, G=Government, C=Case; Rev=Reviewer; Tr=Contradicting comments; I=Interview; W=Workshop

Appendix 8 (cont.)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and Date	Used for which case?
6. Bureaucrats have major responsibility for policy (RTG6)	1. Rational decision-making less possible at senior levels 2. Visibility shifts response to senior levels	1. SCC, 1979; Pross, 1986; Forbes, 1985; Webb, 1987; Dryzek, 1987 2. Chandler & Chandler, 1979; Paehlke, 1987 I.Cd88.G35; I.Ma89.G26 RevTrG60,62,71	Middle management can influence less visible issues that are resolved with group/government negotiation	RTG6.1 9/88	RCG3
7. Difficult for central bureacracies to respond to local and regional needs (RTG7)					RCG4
8. BNA has produced uncoordinated activity and duplication of effort (RTG8)					RCG5
9. Absence of sense of mission amongst Agriculture Canada staff (RTG9)	Not a problem at very senior levels	Plumptre, 1988 Jabes & Zussman, 1988 Osbaldeston, 1988	Sense of mission lacking at junior and middle levels	RTG9.1 7/89	RCG1
10. Poor internal communication and information management (RTG10)	Organizations are often disconnected from information sources	Dryzek, 1987 Plumptre, 1988	Poor internal communication and poor communication with environment they serve	RTG10.1 7/89	RCG5

Code: R=Restraining; T=Theme, G=Government, C=Case; I=Interview; W=Workshop; Rev=Reviewer; Tr=Contradicting comments

Appendix 8 (cont.)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and Date	Used for which case?
11. Ag.Can. goals different from SA goals (RTG11)	RevTrG70,72,77		Many Ag. Can. goals better achieved by SA	RTG11.1 1/89	RCG4
12. Not usually a rational goal setting process (RTG12)					RCG1
13. Several jurisdictions opposed to SA or specifically to organic farming (RTG13)	I.An88.G14		Many jurisdictions are opposed to SA, but there are many internal supporters	RTG13.1 9/88	RCG4
14. No real coordination in decision making (RTG14)					RCG5
15. Legislature provides framework for agricultural legislation, leaves details to bureaucracy (RTG15)					RCG5

Code: R=Restraining; T=Theme, G=Government; C=Case; Rev=Reviewer; Tr=Contradicting comments; I=interview

Appendix 8 (cont.)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and Date	Used for which case?
16. Most marketing boards do not have organic distribution channels (RTG16)	1) Structural problems within marketing boards limits participation 2) Some boards are making changes	1) Canadian Organic Growers, 1989 2) Anon., 1989a; Crowley, 1990	Marketing boards limit development of organic production and distribution but some progress is being made	RTG16.1 10/89	RCG7
17. Labelling regulations are sometimes difficult for organic processors and retailers to follow (RTG17)					RCG7
18. Som rganic producers have difficulty obtaining credit (RTG18)	I.KI88.G18 RevTrG76	Henning et al., 1990	Some organic farmers' credit difficulties may be similar to those experienced by all small farmers	RTG18.1 4/90	RCG7
19. Some sanitation and animal health regulations contravene ideal organic certification standards (RTG19)					RCG7
20. Organic farmers have trouble obtaining crop insurance (RTG20)	I.Ze88.G3; I.Br88.G1; I.Co88.G1; I.Ze88.G1		Some organic farmers have had difficulty obtaining crop insurance, but not usually stabilization	RTG20.1 9/88	RCG7

Code: R=Restraining; T=Theme, G=Government; C=Case; W=Workshop; I=Interview; Rev=Reviewer; Tr=Contradicting comments

Appendix 8 (cont.)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and Date	Used for which case model?
21. Grading criteria discourage sustainable practices (RTG21)					RCG6
22. Production subsidies for crops and livestock may impede farm diversification (RTG22)					RCG6
23. Canada Wheat Board quotas may impede farm diversification (RTG23)	Modifications to quota policy have been proposed recently to reflect concerns	Quota Review Cttee, 1989	Recent proposals to change quota policy may reduce negative impacts	RTG23.1 6/89	RCG6
24. Stabilization programs, price and income supports impede farm diversification (RTG24)					RCG6
25. Transportation programs impede farm diversification (RTG25)					RCG6

Code: R=Restraining; T=Theme, G=Government; C=Case; W=workshop; I=Interview; Rev=Reviewer

Appendix 8 (cont.)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and Date	Used in which case?
26. Crop insurance programs impede farm diversification (RTG26)					RCG6
27. Ontario Drainage Act and municipal taxation impede farm diversification (RTG27)					RCG6
28. Federal fertilizer Act prevents registration of alternative products (RTG28)	I.WI88.G49 RevTrG75		Fertilizer Act is not designed to promote sound agronomic practice	RTG28.1 2/89	RCG6
29. Government does not provide full information on food production practices to consumers (RTG29)					RCG6
30. SA practitioners may not meet eligibility criteria for subsidy programs (RTG30)					RCG8

Code: R=Restraining; T=Theme, G=Government; C=Case; W=workshop; I=Interview; Rev=Reviewer; Tr=Contradicting comment

Appendix 8 (cont.)

Theme (pattern)	Contradicting evidence	Sources	Modified theme	Code and date	Used in which case?
31. SA practitioners may not meet eligibility criteria for business or organizational development programs (RTG31)	I.Ca88.G17		Eligibility can be a problem or support for implementing the supported program	RTG31.1 9/88	RCG8
32. Many existing financing programs have room for a specific SA financing mechanism (RTG32)					RCG8
33. Many existing taxation programs could include a specific taxation mechanism to support SA (RTG33)					RCG8
34. Many jurisdictions have created or could create a legislative or regulatory vehicle to support organic certification (RTG34)	I.Sw89.G20 Kendall & Brusko, 1988		Not all jurisdictions are enforcing the legislation created to support organic certification	RTG34.1	RCG8
35. Research programs limit our understanding of SA (RTG35)					RCG8

Code: R=Restraining; T=Theme, G=Government; C=Case; W=workshop; I=Interview; Rev=Reviewer

Appendix 9
Preliminary themes: research restraining forces (barriers)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence	Used for which case?
1. Most agricultural scientists are not doing research useful to SA	RTS1 2/87	Hill, 1984a; Kramer, 1984	Robinson, 1985; 1986; Baker & Smith, 1987; Blobaum, 1983; I.Ho89.S1,S3; I.Cd88.S24; I.Fi88.S21,S22; I.Ca88.S4; I.An88.S7; RevFiS1	RCS1
2. Development of a community of professional scientists narrowed the field of scientific view	RTS3 3/87	Kuhn, 1970	Mahoney, 1976; Busch, 1980; Bahm, 1979; Capra, 1982; RevFiS9	RCS2
3. Most agricultural scientists see solutions in discrete products and technologies	RTS3 3/87	Albury & Schwartz, 1982; Heffernan, 1986	Levins & Lewontin, 1985; Hadwiger, 1982; Doyle, 1985; OTA, 1986; Buttel, 1986a; Hall, 1974; Vogeler, 1981; RevFiS9	RCS2
4. Not possible to integrate "bits" of disparate research into a comprehensible picture	RTS4 3/87	Miller, 1985a; Busch & Lacy, 1983	Hanway, 1978; Suzuki; 1987; Capra, 1982 W.Wi89.S7; RevFiS9	RCS2
5. Elaborate assumptions required to explain how diverse biological systems can be treated similarly	RTS5 4/87	Bennett, 1986; Miller, 1985a	Dundon, 1982; Capra, 1982	RCS2

Code: R=Restraining; T=Theme; S=Research; Rev=Reviewer; Fi=Confirming comment; W=Workshop; I=Interview

Appendix 9 (cont.)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence	Used for which case?
6. Direct, single cause and effect central to conventional science	RTS6 4/87	Hill, 1980	Hall, 1974; Henderson, 1981; Davenport, 1982; Levins & Lewontin, 1985	RCS2
7. Research focus rests on specific problems related to specific commodities	RTS7 4/87	Busch & Lacy, 1983	Hall, 1974; Hadwiger, 1982	RCS2
8. Scientists believe that fact can be separated from context and design experiments around that assumption	RTS8 4/87	Miller, 1985a; Mahoney, 1976; Busch & Lacy, 1983	Pais, 1982; Davenport, 1982; Maslow, 1966; Shephard, 1985 Busch, 1984; Ruttan, 1982	RCS3
9. Scientists should be detached from socio-economic and political implications of their work	RTS9 4/87	Busch & Lacy, 1983; Miller, 1985a	Hightower, 1972; Hadwiger, 1982; Levins & Lewontin, 1985	RCS3
10. Most scientists and funding bodies believe that quantifiable facts are essential to rational evaluation of information and reality	RTS10 4/87	Mahoney, 1976; Miller, 1985a; Kuhn, 1970	Dundon, 1982; Hall, 1974; Hillel, 1987; Miller, 1987	RCS2

Code: R=Restraining; T=Theme; S=Research; Rev=Reviewer; Fi=Confirming comment; W=Workshop; I=Interview

Appendix 9 (cont.)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence	Used for which case?
11. Most scientists looking for a narrow range of results, so miss the unexpected	RTS11 4/87	Kuhn, 1970; Mahoney, 1976		RCS2
12. Statistical techniques encourage narrow view and quantitative inquiry	RTS12 4/87	Schrecker, 1984; Mahoney, 1976; Miller, 1985a	Truzzi, 1979; Paigen, 1982; Sonntag & Klein, 1977; Grierson, 1980; RevFIS1	RCS2
13. Many conventional scientists don't believe SA provides sufficient opportunities for personal advancement	RTS13 4/87	Dahlberg, 1986b; Miller, 1983b; Busch & Lacy, 1983	Lepkowski, 1982; Madden, 1985; Coleman, 1982; Dundon, 1982; Buttel & Youngberg, 1985; RevFIS9	RCS6
14. Long history of agricultural scientists sharing interests of capitalist class	RTS14 4/87	Albury & Schwartz, 1982; Leiss, 1972; Danbom, 1986; Busch & Lacy, 1983	Gouvernement du Quebec, 1979; Vandermeer, 1981; Hadwiger, 1982; Rodefield, 1978	See Table 34
15. Scientific training is too narrow	RTS15 4/87	Kuhn, 1970; Miller, 1983a; 1984; Danbom, 1986;	Kubie, 1956; Hadwiger, 1982; Hill, 1986b; Mayer & Mayer, 1974; Friedland & Kappel, 1979; W.Sb89.S36; I.Ma89.S31	RCS4

Code: R=Restraining; T=Theme; S=Research; C=Case; Rev=Reviewer; FI=Confirming comment; W=Workshop: I=Interview

Appendix 9 (cont.)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence	Used for which case?
16. Majority of NA agricultural scientists are of similar race, gender and background; encourages conformity and elitism	RTS16 4/87	Busch & Lacy, 1983; Miller, 1982; Bennett, 1986	Hadwiger, 1982; Todd, 1978; Center for Rural Affairs, 1982; Truzzi, 1979; Buttel, 1980	RCS4
17. Agricultural science has helped perpetuate large-scale, capital intensive agriculture	RTS17 4/87	Heffernan, 1986	Hadwiger, 1982; Hightower, 1972; Rodefield et al., 1978; Troughton, 1985; Friedland & Kappel, 1979; Vogeler, 1981	RCS4
18. Many scientists deny that their emotions have an effect on their work	RTS18 4/87	Mahoney, 1979	Kubie, 1956; Hill, 1986b; Maslow, 1966; I.Ma89.S32	RCS3
19. Unresolved emotional traumas can get in the way of good science	RTS19 4/87	Miller, 1983b	Hill, 1987; Kubie, 1956; Maslow, 1966; Mahoney, 1986; Miller, 1987	RCS3
20. Most conventional scientists aren't prepared to work in multi-disciplinary teams	RTS20 4/87	Miller, 1983b; Busch & Lacy, 1983	Mahoney, 1979	RCS6

Code: R=Restraining; T=Theme; S=Research; C=Case; Rev=Reviewer; Fi=Confirming comment; W=Workshop; I=Interview

Appendix 9 (cont.)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence	Used for which case?
21. Senior researchers are often most resistant to changing their orientation	RTS21 4/87	Miller, 1983b	Truzzi, 1979; Savan, 1988; Buttel & Youngberg, 1985 I.Ma89.S27,S30; RevFiS9	RCS7
22. Scientists who do not conform to disciplinary paradigm have been threatened with job loss or lost their job	RTS22 4/87	Busch & Lacy, 1983; Mahoney, 1976	Fujimoto & Kopper, 1975; Paigen, 1982; Hadwiger, 1982; Nelkin, 1984; Manwell & Baker, 1986; W.Sb89.S29	RCS7
23. Selective use or outright fabrication of data or results occurs	RTS23 4/87	Mahoney, 1976	Nelkin, 1984; Doyle, 1985; Coye, 1986; Savan, 1988 RevFiS9	See Table 34
24. Many scientists design experiments to confirm already held beliefs	RTS24 4/87	Kuhn, 1970; Miller, 1985a; Mahoney, 1976	Mahoney, 1979; Savan, 1988; Dundon, 1982	See Table 34
25. Decisions about research direction determined by non-public forces if clear research objectives not publicly determined	RTS25 4/87	Busch & Lacy, 1983; Heffernan, 1986	Shuh (cited in Madden, 1986b); Hadwiger, 1982; Hightower, 1972; Brooks & Furtan, 1985; Savan, 1988; Friedland & Kappel, 1979; Ruttan, 1982; W.Or88.S2; I.Ma89.S27; RevTrG65	RCS9

Code: R=Restraining; T=Theme; S=Research; C=Case; Rev=Reviewer; Fi=Confirming comment; Tr=Contradicting comment; G=Government; W=Workshop; I=Interview

Appendix 9 (cont.)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence	Used for which case?
26. Individual scientists, in the name of academic freedom, are determining overall research direction	RTS26 4/87	Friedland & Kappel, 1979	Gouvernement du Quebec, 1979; Ruttan, 1982; I.Ma89.S27; RevTrG65	RCS9
27. Funding approval tied to reductionist concepts of utility and productivity	RTS27 4/87	Busch & Lacy, 1983; Danbom, 1986	Hadwiger, 1982; Guitard, 1985	RCS9 RCS8
28. Low funding makes scientists insecure about pursuing alternative projects	RTS28 4/87	Busch & Lacy, 1983	Muller, 1980; Center for Rural Affairs, 1982; Dundon, 1982	RCS8
29. Funding periods are usually too short	RTS29 4/87	Busch & Lacy, 1983; MacRae & Mehuys, 1985	Muller, 1980; Sanders, 1982; Buttel, 1986a; W.Sh88.G13; W.Sb89.G38	RCS8
30. Peer review process for funding and publication is weakened by personal biases of reviewers	RTS30 4/87	Cole et al., 1981; Mahoney, 1976	Gouvernement du Quebec, 1979; Davis, 1986; Savan, 1988; W.Sb89,S41,S42; Merton, 1968 Sanders, 1982; Fineman, 1981; Manwell & Baker, 1986;	See Table 34

Code: R=Restraining; T=Theme; S=Research; C=Case; Rev=Reviewer; Fi=Confirming comment; Tr=Contradicting; G=Government; W=Workshop; I=Interview

Appendix 9 (cont.)

Theme (pattern)	Code and date	Initial sources of observation	Supporting evidence	Used for which case?
31. Number of publications is the primary determinant of reward	RTS31 4/87	Mahoney, 1976; Busch & Lacy, 1983	Savan, 1988; Ruttan, 1982 W.Sb89.S30	RCS6
32. Little reward for doing multidisciplinary work	RTS32 4/87	Kuhn, 1970; Miller, 1983b; Busch & Lacy, 1983	Hall, 1974; Ruttan, 1982; RevFiS2; Boody, 1980; Lukens, 1984; Gouvernment du Quebec, 1979	RCS6
33. Administrative structures and personnel do not encourage multidisciplinary work	RTS33 4/87	Busch & Lacy, 1983	Sonntag & Klein, 1977; Ruttan, 1980; Hadwiger, 1982; Gouvernement du Quebec, 1979; Caye & Sachs, 1982; RevFiS2	RCS5
34. Few Canadian universities provide SA education programs	RTS34 4/87	S. Hill, pers. comm.	I.Ho89.S1; I.Cd88.S23; Hill, 1989; L. Parent, U. Laval, pers. comm. 11/89; S. Hilts, U. Guelph, pers. comm. 7/89	RCS1

Code: R=Restraining; T=Theme; S=Research; C=Case; Rev=Reviewer;
Fi=Confirming comment; W=Workshop; I=Interview

Appendix 10
Preliminary themes: agribusiness restraining forces (barriers)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence	Used for which case?
1. Corporate concentration in agrifood sector higher than other industrialized nations	RTA1 6/90	Mitchell, 1975; Warnock, 1978; White, 1990	Francis, 1986; Khemani, 1988; Hazledine, 1989; I.GI88.A10,A21; RevFIA4	See Table 41
2. Corporate concentration causes farmer cost/price squeeze	RTA2 6/90	Strange, 1988a; Vogeler, 1981; Warnock, 1978	Warnock, 1979; Greene, 1976; Coffin, 1987; W.Wg88.A11; RevFIA4	RCA1
3. Corporate concentration produces higher consumer retail prices	RTA3 6/90	Parker & Connor, 1987; Marion et al., 1979; Mitchell, 1975	Warnock, 1978; Lerza & Jacobsen, 1975; RevFIA4	RCA1
4. Concentration results in less diversity of farms, rural business and services	RTA4 6/90	Vogeler, 1981; Mitchell, 1975	Kneen, 1990; Warnock, 1978; Coffin, 1987; W.Le88.A5; RevFIA4	RCA1,4
5. Corporations and government exchange senior employees, and represent a network of friendships	RTA5 6/90	Porter, 1965; Newman, 1979; Francis, 1986; McQuaig, 1987	Stanbury, 1988; Davies, 1987; W.Wi89.A7 RevFIA4	RCA2

Code: R=Restraining; T=Theme; A=Agribusiness; Rev=Reviewer; FI=Confirming comment

Appendix 10 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence	Used for which case?
6. Food quality is diminished by centralized food production and distribution	RTA6 6/90	Kramer, 1989; Holmberg et al., 1984; Hall, 1974	PFC, 1980; RevFIA6; Doyle, 1985; Warnock, 1978; W.Or88.A4; W.Wg88.A13	RCA3
7. Environment is damaged by centralized food production and distribution	RTA7 6/90	Perelman, 1976; Giangrande, 1985; Winson, 1988	Coye, 1986; RevFIA6; Blair, 1990; Marquardt, 1989a;	RCA3
8. Agribusiness homogenizes societal values in order to increase demand	RTA8 6/90	Galbraith, 1967; Levitt, 1970	Leiss et al., 1986; W.Le88.A5	RCA4,7
9. Loss of farms due to centralization results in decline in rural population, businesses and social activity	RTA9 6/90	Fujimoto, 1977; Vogeler, 1981; McClatchy & Abrahamse, 1982; Heffernan, 1986	Pugh, 1987b; Batie & Taylor, 1989; W.Wg88.A12; RevFIA6	RCA4
10. Corporate control of capital results in lost opportunities to finance SA initiatives	RTA10 6/90	OTA, 1986; Carlisle, 1987; Aarenstein, 1988	Mitchell, 1975; Francis, 1986; Courchene, 1988; RevFIA13	RCA5

Code: R=Restraining; T=Theme; A=Agribusiness; Rev=Reviewer; Fi=Confirming comment

Appendix 10 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence	Used for which case?
11. Public subsidies to agribusiness represent an opportunity cost for financing SA initiatives	RTA11 6/90	McQuaig, 1987; Mitchell, 1975; Francis, 1986	Kneen, 1990	RCA5
12. Lost tax revenues represent a lost financing opportunity for financing SA initiatives	RTA12 6/90	Kierans & Stewart, 1988; McQuaig, 1987	Ternowetsky, 1989	RCA5
13. The current North American tax regime encourages corporate concentration	RTA13 6/90	McQuaig, 1987; Ward et al., 1989	Nader et al., 1976; Francis, 1986; Wolfson, 1988	RCA5
14. Consumer choice is limited by agribusiness practices	RTA14 6/90	White, 1990	Kneen, 1989a; Hall, 1974; Leiss et al., 1986; Singer, 1986; W.Wg88.A16,A18; W.Wi89.A6; RevFiA9,16	RCA7
15. Agribusinesses use information to control other sectors of the food system	RTA15 6/90	Morgan, 1980 I.Gi88.A12	Kneen, 1990	RCA7

Code: R=Restraining; T=Theme; A=Agribusiness; Rev=Reviewer; Fi=Confirming comment

Appendix 10 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence	Used for which case?
16. Corporations are no longer controlled by the shareholders	RTA16 6/90	Nader et al., 1976; Kierans & Stewart, 1988	Francis, 1986; RevFiA10,17	RCA8
17. Legal changes to the status of the corporation have made it an instrument of private rather than public utility	RTA17 6/90	Nader et al., 1976; Kierans & Stewart, 1988 Mintz & Cohen, 1976	RevFiA17	RCA8
18. Ownership of Canadian agribusiness firms is narrowly held	RTA18 6/90	Mitchell, 1975; White, 1990	Davies, 1987; RevFiA17; Francis, 1986; Giangrande, 1985	RCA9
19. Current economic analysis only measures a limited portion of human activity	RTA19 6/90	Henderson, 1981; Schumacher, 1973; Dyson & Nicholls, 1983	Ekins, 1986a; Robertson, 1983	RCA6
20. Private firms externalize the environmental and social costs of their activities	RTA20 6/90	Georgescu-Roegen, 1971; Schumacher, 1973; Henderson, 1981	Ekins, 1986a; RevFiA18; Callicott & Lappe, 1988; Kierans & Stewart, 1988	RCA6

Code: R=Restraining; T=Theme; A=Agribusiness; Rev=Reviewer; Fi=Confirming comment

Appendix 10 (cont.)

Theme (pattern)	Code and Date	Initial sources of observation	Supporting evidence	Used for which case?
21. Price is an inadequate measure of value	RTA21 6/90	Madden, 1986a; Schumacher, 1973; Henderson, 1981	Kierans & Stewart, 1988; Ekins, 1986a; RevFiA18	RCA6
22. Conventional economic analysis favours centralized production and distribution	RTA22 6/90	Henderson, 1981; Schumacher, 1973;	Ekins, 1986a; RevFiA18	RCA6
23. Markets are not competitive in any classical sense	RTA23 6/90	Schumacher, 1973	Kierans & Stewart, 1988; RevFiA18	RCA6

Code: R=Restraining; T=Theme; A=Agribusiness; Rev=Reviewer; Fi=Confirming comment

Appendix 11

The role of synthetically-compounded fertilizers and pesticides in suppressing desirable soil biological activity

Conclusions regarding suppression of soil biological activity by agricultural chemicals are generally controversial, and for a number of reasons.

The first difficulty is that studies in this area are methodologically and conceptually difficult. The organisms involved are often poorly understood and their living conditions are difficult to control. It appears that the relations between agrichemicals and soil organisms are not linear. Cause and effect is difficult to find. The best work in this area appears to be done by those with training in ecology because they are methodologically and conceptually better prepared for these difficulties. Agroecology is, however, a young discipline (about 50 years) without the track record or well defined techniques of other agricultural sciences.

The second difficulty is that there exists among many agricultural professionals a reluctance to seriously consider that agrichemicals, particularly fertilizers, can have such effects (see Section 5.2 for a discussion). One way this attitude is expressed is by focussing on problems associated with the use of manure or compost in order to deflect attention from synthetic fertilizers. It is true that manure or compost can cause problems, but this is related more to management than to the nature of the material. With fertilizer, as we explore briefly below, the nature of the material is a primary problem.

The third principal problem is related to the first two. Insufficient work has been done in this area, particularly with regard to fertilizers. Our belief is that considerable refinement to our present conclusions about the role of synthetically-compounded materials would be possible following a comprehensive research effort. It is critical, however, that these studies focus on direct and indirect effects, on the short and long-term. Too much work has focused on the populations of a few organisms without considering their relationship to the broader ecological community. Insufficient attention has been paid to the implications of long-term, regular applications of agrichemicals for soil organisms, and the interactions between agrichemical use and other agricultural practices.

The data on the negative effects of pesticides on soil organisms is more conclusive than that for fertilizers, especially for soil fauna (cf. Pimentel, 1971; Edwards and Thompson, 1973; Theiling and Croft, 1988). Effects are more noticeable in certain organisms and due to certain pesticides. Similar impacts have been observed on soil insects and microorganisms (cf. Audus, 1970; DeBach, 1974; Alexander, 1977; Hill, 1978; Madge, 1981; Arden-Clarke and Hodges, 1988).

Generally, direct and indirect, lethal and sublethal effects are observed. Imbalances between predators and pests are created, often by suppressing or encouraging one at the direct or indirect expense of the other. Communities are generally simplified (cf. Edwards and Lofty, 1969; Edwards and Thompson, 1973; Adrén and Steen, 1978; Edwards, 1981). Sublethal effects are more difficult to determine and have received less attention but may be particularly important as chemical residue levels decline (cf. Hill, 1978). Minor disruptions to populations due to sublethal effects may effectively render ineffective a natural control

(Theiling and Croft, 1988). Observations on agricultural land are complicated by the masking compensatory effects of cultivation and fertilizers.

Fertilizers have been reported in the literature to increase soil animal populations, largely due to the increase in crop biomass (cf. Marshall, 1977). It appears premature to conclude from this that fertilizers have beneficial effects because this conclusion hides a myriad of indirect adverse changes to soil populations. Hill et al. (1975), for example, in a review of forest soil fertilization, identified 8 indirect pathways that can modify soil organism populations. Negative consequences are also reviewed by Weetman and Hill (1972) and Arden-Clarke and Hodges (1988). Generally, the application of fertilizers (and manure and compost at high doses) results in concentrates at levels rarely experienced by soil organisms in a state unmanipulated by humans. Organisms that proliferate in environments of low concentrations of a given nutrient are suppressed (e.g., mycorrhizae and rhizobium in the presence of soluble N, cf. Mosse [1986] and Patriquin et al. [1986]).

Even if the impacts of synthetically-compounded fertilizers are minimal, we are missing the opportunity to manage soil organisms in a way that will make dependence on them unnecessary (cf. Hill, 1985b). Given the economic and ecological costs of fertilizers, it is sensible to design systems without them.

In the face of these scientific uncertainties, sustainable agriculture proponents favour an environmentally cautious approach that minimizes the use of synthetically compounded materials. Following a comprehensive research effort, some of these materials may be deemed acceptable and be reintegrated into sustainable farming systems.

Appendix 12

Some positives and negatives in the 1985 and 1990 USA Farm Bills

Canadian policy makers have been following USA attempts to resolve agricultural and related environmental problems. The 1985 Bill included sections on commodities, trade and farm support provisions, as well as a Conservation Title. All of these have had an impact on issues of sustainability and the pros and cons of these provisions are part of the assessment underway for 1990. What follows are conclusions extracted from some of the literature on the 1985 and 1990 Farm Bills.

Positives

1. **Cross-compliance** is perceived as generally desirable and effective. It has created more consistency in programming. In 1990 it is likely to be extended to more areas including groundwater contamination, farm credit and possibly certain tax benefits (Benbrook, 1988).
2. **Sodbuster and swampbuster provisions** have reduced the breaking of marginal agricultural land and have protected sensitive natural areas (Myers, 1988b).
3. **Conservation reserve** now includes 28 million acres (of a 1985 Farm Bill 5-year goal of 45 million). It has so far been used for erosion hazard areas, but regions susceptible to water quality problems may be added for 1990 (Kemp and Lamb, 1989). In early 1988, the estimated erosion reduction was 467 million tons/year (Myers, 1988b).

4. Commodity supports have contributed to an improved economic situation for farmers largely through reduction of commodity loan rates to make USA products more competitive internationally (Paarlberg, 1989).

5. The 1985 Bill has contributed to increased farmer awareness of environmental problems (Larson, 1988).

Negatives

1. The USDA has been too lax in enforcing the erosion control goals under cross-compliance (Benbrook, 1988; Scaling, 1988; Stoddard, 1988; Robinson, 1989). The 1990 Bill may return to a T-based standard with regional flexibility to accommodate solid evidence of economic difficulty (Benbrook, 1988; American Soybean Association, 1989).

2. There is some concern that the Conservation Reserve Program (CRP) will not be effective unless it is bridged to sustainable, profitable land use (Benbrook, 1988; Ward et al., 1989). If this does not happen, land may not remain out of production after 10 years. In the south CRP land can be put into trees and produce financial return for the long-term. This option does not exist for other regions (Benbrook, 1988).

3. The state has some control over CRP land so it can spray if a spraying ordinance has been passed. This is discouraging some organic producers from participating in the CRP (Robert Swann, South Berkshires Community Land Trust, Great Barrington, MA, pers. comm., July, 1989).

4. Swampbuster provisions define a violation as the planting of a commodity crop on drained land, not the draining of the land itself. This reduces the effectiveness of the program and creates administrative problems (Jones, 1988; Robinson, 1989).

5. There is concern about a loss of credibility for the Soil Conservation Service due to the reduction of local input into the development of alternative conservation systems in exchange for more top-down decisionmaking (Stoddard, 1988).

6. Set-aside programs appear to be intensifying chemical use and less sustainable practices on remaining acreage (Fleming, 1987).

7. The per-unit basis of support payments for corn, cotton, wheat and soybeans is encouraging extra agrichemical use and cropping of these four commodities (Fleming, 1987; Goldstein and Young, 1987). Base acres should be determined by suitability of the land to grow the crop not previous cropping history (American Soybean Association, 1989).

8. The costs of agricultural programs have increased substantially (Paarlberg, 1989). Expansion of the CRP could also contribute to increased costs unless expansion is tied to expenditure rather than acreage (Hertel and Preckel, 1988).

9. Price support programs are penalizing LISA systems (Goldstein and Young, 1987; Crosson, 1989). Planting of more legumes and cover crops should be eligible without losing base acres (American Soybean Association, 1989; Robinson, 1989). House Bill 2799, approved in July, permits planting of alternative crops on 20% of base acreage. Unfortunately, legumes are not included, but such crops as sunflowers, canola, kenaf, guayule and milkweed are (Anon., 1989e). The bill must still pass the Senate. Dobbs et al. (1988) have shown how, in most cases, alternative systems are more profitable than chemical-intensive ones once price supports have been removed. The General Accounting Office (1988) has concluded that rigidities in the 1985 bill must be removed so that farmers

can be more responsive to market conditions, while still leaving the USDA room to influence cropping patterns.

10. Decoupling has been considered for a number of years (OECD, 1983; Economic Council of Canada, 1988), but will only contribute to sustainability if payments are recoupled to sustainable farming practices (Kroese, 1989; Madden, 1989). Kneen (1989b) has concluded that the decoupling proposal as it currently stands would heighten the role of the "environmentally-flawed" market place, increase profitability for large food corporations, and ultimately contribute to further environmental degradation. A new bill, sponsored by Senator Rudy Boschwitz, being considered in the 101st Congress, is designed to address the demand to ". . . recouple income subsidies to environmentally-sensitive practices." (Benbrook, 1989:21).

11. The adminstrative burden of the 1985 bill has caused considerable problems for county offices of the Agricultural Stabilization and Conservation Service. Work load has increased by 38% and 29% more permanent full-time staff have been hired between 1985 and 1988 to deal with the additional yield payments, commodity certificates, CRP, Dairy Termination program, sod/swampbuster and cross-compliance provisions, new methods for determining crop acreage base, and new loans. The bill has brought with it a greatly increased flow of paper work, everchanging regulations, low staff morale, numerous errors, and inadequate verification of cross-compliance (General Accounting Office, 1988).

12. The CRP is resulting in landlords forcing out tenants occupying reserve lands without tenants receiving any substantial share of CRP benefits and the USDA response to this situation has been inadequate. The

CRP has also, in some cases, contributed to land speculation (Strange, 1988b).

There are several bills before Congress presently (Leahy, Lugar, Fowler, Jontz for example) that will become part of the 1990 Farm Bill or have a major impact on its final composition. Although some initiatives appear to be promising in the short term, the Farm Bills are deficient because they fail to focus on redesign as the ultimate objective of the transition process. This accounts, in part, for the mixed results that have been achieved to date. The root causes of man of the problems are not being addressed. The analyses are too limited and could slow or even derail progress toward sustainability.

Appendix 13
Examples of possible medium term objectives
for implementing sustainable agriculture
(adapted from Friedland and Kappel, 1979; Christianson, 1988)

To help achieve which long-term goal? (Table 51)	Medium-term goals
<u>Financial and Market</u>	
ABEIJ	1. The share of total retail food sales for organically grown food increases from its current estimate of 0.25% to 2% within 10 years.
DG	2. Return on investment (ROI) should be 5-10% for each of farmers, processors, distributors and retailers.
ADG	3. Organic food is priced at 20-25% above conventional prices in the short term, falling to 5-10%.
BDFH	4. Level of shrinkage (food discarded) is maintained at 5-10% (approximately 20% in conventional systems) and develop composting systems to recycle the shrinkage.
BDH	5. Develop reusable, recyclable and biodegradable pack aging and encourage its use at the rate of 10% per year (completed by 2000).
ADIJK	6. Allocate 1% of sales to public and professional education on the urgency of developing sustainable agriculture.
<u>Resources</u>	
CDF	7. The total volume of non-renewable energy consumed in all phases of agricultural production should be held to a constant within five years and a decline in all such energy consumed by 20% is desirable within 10 years.
CDEF	8. The total volume of chemical applications in agriculture should drop by 50% within 15 years.
CDF	9. Any specific crop that has more than 60% of its total Canadian acreage planted to four cultivars or less, must have that 4-cultivar acreage decreased by 20% within 10 years so that production is less susceptible to pests and disease.
DFHK	10. The number of acres planted to corn and wheat must decrease by 20% within 10 years. This is desirable in order to diversify crops, promote crop rotation and soil conservation, and reduce dependency on export markets.
<u>Socio-economic factors</u>	
GHI	11. It is desirable that the decline in the number of farms be brought to a halt. The rate of decline should be reduced to 2 % within 5 years; by 2000 the rate of decline should should approximate zero. Further, by 2010 the increase in the total number of farms should be large enough to be registered in demographic analysis with statistical significance.
GIJ	12. Distribution of income within the agricultural sec-

tor should, within a period of ten years, become more equitable. Equitability involves a better distribution of income to farm workers, to workers who might trans fer to self-directed production, and to small farms, e.g., there should be a 10% reduction in the share of agricultural income earned by the top 25% of farmers within 10 years.

ADEGH

13. Based on the existing degree of concentration (the number of firms and the degree to which market shares are distributed among the firms) in a specific production system involving an agricultural commodity or commodities (including input supply, processing, wholesaling, and retailing), it is socially desirable that no further concentration develop.