

**SUSTAINABLE AGRICULTURE:
FUTURE DIMENSIONS**

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SUSTAINABLE AGRICULTURE: FUTURE DIMENSIONS

THE RESOURCE BASE

We can ignore the state of global land and water resources only at our great peril. We tend to assume that environmental degradation is a contemporary condition, but there is historical evidence to show that cultures rise and fall on their agricultural base's ability to support the rest of society. The balance between population and agricultural productivity becomes more and more precarious as a society becomes more complex and the drive for a continuing food supply to support all the non-producers places more and more demands upon land and water resources. The histories of the Mesopotamian, the Mediterranean and the Mayan civilizations suggest that ever greater use of resources without accompanying stewardship leads to societal disintegration.

We now face a scenario in which global exploitation of resources has expanded a local environmental phenomenon into a world-scale problem.⁽¹⁾ The former Soviet Union may be the first modern example, since that country's economic breakdown came about largely because of the collapse of the food supply and distribution system. This collapse has worldwide ramifications, which the have-countries in particular realize, and are now scrambling to contain.

Already, 6% of the earth's surface is classified as extreme desert, and a further 29% is subject to varying degrees of desertification.⁽²⁾ Any expansion in the extent or intensity of agricultural production would require sustainable management of the land-water-vegetation system. The next section looks at what this would entail.

(1) Clive Ponting, "Historical Perspectives on Sustainable Development," *Environment*, Vol. 32, No. 9, November 1990, p. 33.

(2) Advisory Panel on Food Security, Agriculture, Forestry and Environment, *Food 2000: Global Policies for Sustainable Agriculture*, Report to the World Commission on Environment and Development, Zed Books Ltd., London, 1987, p. 60.

WHAT IS SUSTAINABLE AGRICULTURE?

Is sustainable agriculture a philosophy, a system of farming or a management strategy? It has been called all three, and each term adds a perspective which helps explain the complexity of this multi-dimensional concept. From the difficulties evident in gaining a consensus on the definition, it is obvious the term has different meanings for different people.

Organic farmers tend to equate “natural” with “sustainable” and consider that their methods follow the tenets of a sustainable system. Their approach goes beyond methodology to embrace a philosophy of co-existing with nature rather than exploiting it.⁽³⁾ It involves benign designs and management procedures that work with natural processes to conserve all resources, minimize waste and environmental impact, and promote agro-ecosystem resilience.⁽⁴⁾

Mainstream farmers would contest the claim that organic farming is the farming most closely associated with sustainable agriculture, since many of them are also using methods they consider conserve or enhance the natural resource base. This position, upheld by federal and provincial governments, places organic agriculture within a broad spectrum of agricultural methodologies that support the environment. These range from conventional, and more intensive, methods to alternatives such as biodynamic practices.⁽⁵⁾

Certainly, as one moves from broad principles to actual farming practices, the differences between approaches become less discernible. Methods of production are evolving all the time, and the same ones may be practised along a continuum of farming from mainstream to organic. Practices associated with the term “sustainable” may include crop rotation, snow and stubble management, annual legumes, minimum tillage, or reduction of inputs. Many pre-date the Green Revolution of the 1960s and 1970s and prompt questions about just how modern is the concept of sustainable production. For instance, some sustainable proponents stress reduction of inputs as crucial, yet in the dryland wheat areas of the west, fertilizers and pesticides were not relied on until herbicide-based chemical fallowing was introduced after World War II. The Dust

(3) F.L. McEwen and L.P. Milligan, *An Analysis of the Canadian Research and Development System for Agriculture/Food*, Report commissioned by the Science Council, July 1991, p. 20.

(4) *Ibid.*, p. 18.

(5) Agriculture Canada, *Progress Report on the Development of Organic Certification Standards and Accreditation System*, December 1991, p. 1.

Bowl of the 1930s, however, shows that the low-input system prevalent at the time proved unsustainable under adverse climatic conditions.⁽⁶⁾ It is somewhat ironic that there may be a certain reluctance to re-introduce such things as crop rotation, shelter belts or fewer inputs, which, in an era when most farmers have embraced “high tech” production, are associated with outmoded practices. We must conclude that, while the methods may differ, the modern term “sustainable” encompasses the ability to maintain productive capability even in the face of economic and climatic setbacks.

Expectations for sustainability date from the 1987 publication of the Brundtland Report, *Our Common Future*,⁽⁷⁾ which popularized the term “sustainable development.” The report stressed that present economic needs should not compromise future needs and that current approaches that contribute to environmental degradation do not contribute to sustainable development.

The World Commission on Environment and Development ties economic survival to the health of our natural resource endowment and the efficient use of scarce resources to benefit both present and future generations. The natural resource base remains crucial, but if the farmer is not receiving adequate returns on capital and labour, his farming operation will not be viable even in the short term. In the long term, if the economics seem right but the resource base is being depleted, the operation will not be sustainable. Efforts to ensure short-term viability must be tested against long-term durability if farming is to meet the new goal of being sustainable.⁽⁸⁾

The Canadian government has committed itself to sustainable agriculture as part of its ongoing review of the agricultural system, instigated by current GATT (General Agreement on Tariffs and Trade) negotiations. Farmers themselves are already taking steps in this direction. In January 1992, members of 50 Ontario farm organizations came out in support of a farming environmental agenda. As farmers, they felt that they were in the best position to encourage farming activities that respect the environment. For widespread adoption, however, it is important to know whether sustainable agriculture depends upon a conducive socio-economic

(6) William Lockeretz, “Major Issues Confronting Sustainable Agriculture,” *Sustainable Agriculture in Temperate Zones*, Charles A. Francis, Cornelia Flora Butler, Larry D. King, eds., John Wiley & Sons, New York, 1990, p. 428.

(7) World Commission on Environment and Development, *Our Common Future*, Oxford University Press, Oxford, 1987.

(8) McEwen and Milligan (1991), p. 18.

climate.⁽⁹⁾ If farmers cannot switch production systems without significantly changing their attitude, pouring money into these new approaches will not bear fruit. There is no question that establishing sustainable agriculture will involve adjustments. It is fairly safe to assume that the more major these are, the greater the likelihood that their adoption will require a comparable adjustment in attitude. To take a case in point, sustainable agriculture favours diversification over specialization. If this option turns out to have a less attractive economic return, then it must be the well-being of future generations or the well-being of the soil that motivates the choice for a diversified production method. Until non-economic values become as important as the bottom line, a farmer is unlikely to be motivated to adopt the new approach. Consequently, stressing diversification without understanding the key motivators and what rewards farmers find acceptable, will not lead to its adoption.

In any event, the economic incentive proves to be a fickle indicator of commitment to change. When prices are low, interest in reducing costs is high and may lead to a reduction in inputs or conservation tillage in order to save money. A turnaround in prices may, however, result in an increased use of inputs, or more cultivation of marginal land. A sustainable approach should go beyond short-term considerations; nevertheless, a system which does not return enough income for the farmer to stay in business is obviously not sustainable.⁽¹⁰⁾

IS THE LAND RESOURCE BASE SUSTAINABLE?

It has been established that, on a global basis, there is not sufficient land capable of producing food to meet the world's requirements. In Canada, prime agricultural lands (Class 1) occupy only one-half of 1% of the country's land area, and other such dependable land (Classes 2 and 3) covers about 4.5%. The remaining 2% of land suitable for agriculture is classified as marginal for cropping purposes but does have some potential for forage-based animal enterprises.⁽¹¹⁾

(9) Lockeretz (1990), p. 429.

(10) *Ibid.*, p. 431.

(11) N.R. Richards, "Historic and Current Activities in Soil Conservation," *In Search of Soil Conservation Strategies in Canada*, Conference Proceedings, D.W. Anderson, ed., 1-3 April 1986, Agricultural Institute of Canada, Ottawa, 1987, p. 34.

Not only is this arable land base limited, its quality has been rapidly deteriorating as a result of wind and water erosion, soil salinization, acidification, soil compaction and loss of soil organic matter.⁽¹²⁾ Wind and water erosion affects about 11.5 million hectares of land across the Prairies and salinization affects another 2 million hectares.⁽¹³⁾ In Quebec, 43% of cultivated cropland suffers from organic matter loss and/or compaction, 18% from overfertilization, 12% from acidification, and 10% from erosion. Concerns about soil erosion and water quality are typical of Ontario, while the Maritime region is trying to address water erosion and quality, and soil acidity.⁽¹⁴⁾

Each of these factors is heavily influenced by the individual farmer's choice of cropping system and soil management. In many cases, soil salinity and acidity are natural problems with which the farmer must contend.⁽¹⁵⁾

From the farmer's point of view, it would be useful to know to what extent it has been possible to maintain production only at the expense of the resource base.⁽¹⁶⁾ The market economy tends to emphasize the value of current production over the value of the land resource for future production. This ties the farmer, particularly during adverse periods, to production practices that have historically met the short-term test of profitability and minimized risk, but that may fly in the face of long-term soil fertility. Yet it pays farmers to respect the soil as a precious natural resource, since they are so dependent on its fertility. Indeed, most farmers have a deeply ingrained sense of stewardship for their land and would be unwilling to sacrifice its quality for the sake of short-term gains.⁽¹⁷⁾ It makes little sense for any producer to exploit the land resource for short-term profit if this is likely to compromise long-term food production capability.

The impact of soil degradation on production yields and costs may not be immediately apparent, given changing cultivation practices or technological improvements. Soil

(12) J.C. Gilson, "Federal Policies and Soil Conservation," *ibid.*, p. 43.

(13) Parliament, House of Commons, Standing Committee on Agriculture, *Minutes of Proceedings and Evidence*, Issue No. 9, 21 October 1991, p. 36-41.

(14) Agriculture Canada, Research Branch, *Report to the House of Commons Committee on Agriculture on Recent Advances in Soil and Water Degradation Research*, 9 March 1991, p. 1, 4, 6.

(15) H.D. McRorie, "Farm Production and Its Relationship to Soil Conservation," from *In Search of Oil Conservation Strategies in Canada* (1987), p. 92.

(16) D. Knoerr, "Conservation Farming in the 1980s," *ibid.*, p. 85.

(17) McRorie, *ibid.*, p. 91.

erosion is pervasive, rather like an unrelenting fatal disease that is not immediately recognized but, once entrenched, is difficult to eradicate. While soil degradation may be found in farming operations all across the country, factors such as quality and composition of the soil, amount and distribution of precipitation, length of frost-free periods, and other natural phenomena obviously affect the amount and rate of deterioration.⁽¹⁸⁾ That is why human impacts on the soil are difficult to quantify and solutions must be farm-based. What may be acceptable practice on one farm may not be so across the farm boundary or county line. Farm practices largely determine whether an agricultural system is sustainable,⁽¹⁹⁾ a subject that the next section will address.

Losses due to soil degradation are not confined to the farm. Off-farm costs include water pollution, sedimentation and flooding.⁽²⁰⁾ Soil degradation may also result from any land disturbance, contamination, sewage disposal and conversion of high-quality agricultural land to non-agricultural uses.⁽²¹⁾ Those losses that stem from urban and industrial growth will be dealt with separately later in the paper.

FARM PRACTICES

The three approaches covered in this section represent two extremes of farming systems and a possible compromise. Farming techniques are in a continual state of evolution so that what is a typical methodology in one period is not necessarily so a few years down the road. Sustainable farming is high-quality farming, and does not depend on specific practices. The criterion is potential for continuous viability, which may have to vary from farm to farm in response to a particular situation.

(18) Knoerr, *ibid.*, p. 92.

(19) Canadian Organic Growers, Brief to the House of Commons Standing Committee on Agriculture, January 1991, p. 1.

(20) Gilson, from *In Search of Soil Conservation Strategies in Canada* (1987), p. 43.

(21) McRorie, *ibid.*, p. 92.

A. High-Tech Farming

After World War II, the drive to increase food efficiency led to an energy-intensive agriculture, based on inexpensive oil. The use of herbicides, pesticides and synthetic fertilizers expanded, bringing about a corresponding increase in production. Because much of this farming was done on a much larger (and probably more mechanized) scale than formerly, it is sometimes referred to as “industrial” farming. Many farmers continue to farm this way; however, some components of this method are emerging as unsustainable. For instance, in the drylands of the Prairies, essential parts of this system were intensive tillage and summer fallow. Research studies now show that, used together, these two farming methods encourage loss of water and organic matter, and leave the soil in a high-risk condition. Consequently, the annual returning of crop residues to the soil is now being advocated in order to improve soil organic matter. Chemical fallow is being suggested as an alternative to intensively-tilled fallow for conserving the soil and its water content. Other adaptations to increase the sustainability of this type of agriculture are diversification of crops and livestock, better weed and fertilizer management, more careful capture of snow water, and return of cover crops, shelter belts, woodlands and wetlands.⁽²²⁾

B. Organic Farming

An earlier section described the applicability of some organic methods to sustainable agronomic practices. This section explores the evolution of organic farming in North America in view of the controversy about its connection with sustainable agriculture.

A 1980 United States Department of Agriculture (USDA) study provided information on the characteristics of organic farming. Practitioners were generally experienced farmers who owned their land. In many cases, they had shifted from chemical to organic farming for such reasons as considerations of soil health, food safety, environmental protection, and soil and water conservation.⁽²³⁾ They were generally seen as good managers dedicated to responsible husbandry of their soil, crops and livestock. With few exceptions, they were

(22) D.A. Rennie, “Contemporary Agriculture — Evolving into Sustainability,” *Sowing the Seeds for Sustainable Agriculture*, Vol. 1, Proceedings of the Travelling Symposium, 11-16 February 1991, p. 5-6.

(23) U.S. Department of Agriculture, Study Team on Organic Farming, *Report and Recommendations on Organic Farming*, Washington, 1980, p. 11.

following acceptable soil, water, and energy conservation practices. Most had systematically, and largely through their own efforts, developed crop and/or animal management systems well adapted to their specific conditions, including climate, soil, available capital, and accessible organic materials for recycling.⁽²⁴⁾

Early research evidence suggests organic agriculture has the potential to be profitable, given a receptive market, in that premium prices and lower input costs tend to offset the impact of lower yields.⁽²⁵⁾ In Canada, although there is some organic grain farming, most organic farmers are in niche marketing of organically grown vegetable and fruit produce.

The Canadian organic movement emerged during the 1950s, when several successful organic farms were established and some publications appeared. By the 1970s, organic organizations in six provinces were actively lobbying provincial departments to become interested in sustainability. With a fair degree of regional variation, the organic industry grew rapidly during this period and into the 1980s. A number of certification associations were established across the country which aimed to standardize terminology and make creditable organically produced products.⁽²⁶⁾

In December 1988, the federal government began working with the organic industry on incorporating various facets of the industry, including the term “organic,” in legislation and on assigning penalties for false labelling of organic produce. A regulatory framework, in which an acceptable industry certification standard and accreditation system can operate, is scheduled for public review on the completion of industry certification standards and an accreditation model.

This process has been undertaken by the industry through a coordinating body, the Canadian Organic Unity Project (COUP), which has been developing certification standards and an accreditation system for certifying agencies that will be recognized not only in this country but also by Canada’s trading partners. The accreditation body will administer and update standards and accredit agencies to certify organic products, using the Canadian organic standards and trademark. The industry expected to finalize the development of certification

(24) *Ibid.*, p. 78.

(25) Agri-Features Press Release, p. 7.

(26) Stuart B. Hill and Rod J. MacRae, *Organic Farming in Canada*, Presentation to the 7th IFOAM Scientific Conference, Budapest, Hungary, 27-30 August 1990, p. 3-4.

standards and an accreditation system by 31 January 1992; however, this should come about during 1992. Federal legislation will be required to put these systems in place.

At their meeting in July 1991, federal and provincial agriculture ministers agreed to proceed quickly with national organic standards. The provinces would remain free to establish their own regulations and trademarks, providing they did not inhibit interprovincial trade of organic products.⁽²⁷⁾

For many farmers, the term “organic” has a distasteful ring, associated with the rejection of time-honoured “high tech” farm practices. Such farmers also resent the inference that somehow the latter practices are less safe than organic ones. In the process of developing a regulatory system for organic farming, the Canadian Agricultural Research Council Ad Hoc Committee on Organic Food emphasized that the Canadian agri-food supply comes under a stringent food inspection system which assures food safety, regardless of the method of operation.⁽²⁸⁾

C. Alternative Farming Systems

Although there will continue to be farmers who, for philosophical or other reasons, refrain from using synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives, many other farmers, for practical reasons, are adjusting their techniques to suit today’s requirements. Confronted with low prices, reported off-farm pollution impacts, degraded soil, and high production costs, contemporary farmers are seeking new ways to reduce production costs and any perceived negative impacts of their methods of farming. The term “alternative agriculture”⁽²⁹⁾ has been coined to describe these new practices.

Many components of alternative agriculture are derived from conventional agronomic practices and livestock husbandry. According to the U.S. National Research Council, the hallmark of an alternative farming approach is not the conventional approaches it rejects but

(27) Agriculture Canada, *Progress Report on Development of Organic Certification...* (1991), p. 3.

(28) *Ibid.*, p. 1.

(29) U.S. National Research Council, *Alternative Agriculture*, National Academy Press, Washington, D.C., p. 3.

the innovative ones it includes.⁽³⁰⁾ The Council goes on to say that, in contrast to conventional farming systems, alternative systems more deliberately integrate and take advantage of naturally occurring beneficial interactions. Alternative agriculture is not, however, a single system; it covers a spectrum ranging from systems that use no synthetic chemical inputs, to systems involving the prudent use of pesticides or antibiotics to control specific pests or diseases. Successful alternative farmers do what all good managers do — they apply management skills and information to reduce costs, improve efficiency, and maintain production levels.⁽³¹⁾ In the U.S., use of components of alternative systems was found to be quite widespread, despite a lack of R&D support for developing practical solutions.⁽³²⁾ Most farmers had adopted these practices gradually as they became more knowledgeable about pest management, plant nutrition, the genetic and biological potential of cultivars and livestock, and better management techniques.⁽³³⁾

Practices and principles emphasized in alternative systems include: crop rotation, integrated pest management, management systems that improve plant health and the ability of crops to resist insect pests and diseases, soil and water conservation tillage, and genetic improvement of disease-resistant crops and crops that use nutrients more effectively.⁽³⁴⁾ Many of these practices are already part of high-quality farming in Canada, even though the term “alternative” in this sense is not yet a household word. Certainly, alternative farming includes elements similar to those stressed in the Report of the Federal-Provincial Agriculture Committee on Environment Sustainability as being necessary if Canadian agriculture is to become more sustainable.⁽³⁵⁾

The U.S. study found that there were technical and policy barriers to the adoption of alternative technologies. The same barriers hinder sustainable agriculture itself, a subject that will be pursued in later sections of the paper.

(30) *Ibid.*, p. 3.

(31) *Ibid.*, p. 4.

(32) *Ibid.*, p. 7.

(33) *Ibid.*, p. 9.

(34) *Ibid.*, p. 5.

(35) Federal-Provincial Agriculture Committee on Environmental Sustainability, *Report to Ministers of Agriculture*, Ottawa, 30 June 1990, p. 28.

EFFECTS OF LAND USE CONFLICTS ON THE AGRICULTURAL LAND BASE

The World Watch Institute, an influential Washington think-tank that focuses on farming and food problems, considers that the increase in food production created by machines, fertilizers and pesticides after World War II has reached a plateau and will not be perpetuated. Growth in the world's irrigated area has slowed to a crawl and high-yielding, fertilizer-responsive crop varieties are now planted on nearly all of the suitable land.⁽³⁶⁾ This suggests the need to protect the farmland that is left.

It falls to the farmers, who may consider land as their retirement fund, to conserve its benefits for future generations. Yet it does not at present pay farmers to hold on to their land, particularly near urban centres, where much of prime agricultural land is located, when its use for development makes it so much more valuable than its use for agriculture. There is no incentive for land transfer from one generation to another to ensure that the land stays in production.

Only a small amount of agricultural land is lost to urban development, but it is usually the best agricultural land and it is likely lost for all time.⁽³⁷⁾ Between 1966 and 1986, 307,500 hectares of land, of which 58% was prime agricultural land, went to urban expansion.⁽³⁸⁾ To replace equivalent agricultural production from lower class land would require twice the land area. Some provinces have moved to restrict speculative uses of agricultural land. These include Prince Edward Island, Quebec, Ontario, Manitoba and British Columbia.

Only about 4% of the land in British Columbia is suitable for agriculture and it is in areas of the greatest urban pressure. This was perhaps the main reasoning behind the passing of the *Land Commission Act* in 1973. The Land Commission has had moderate success in designating land as agricultural land and restricting non-agricultural uses.

In the Province of Ontario, the climate and the soils of the Niagara region are uniquely suited for growing tender fruits and in the past provided Canadian consumers with reasonably-priced produce. Cheaper products entering Canada from the U.S. have made it

(36) *Ottawa Citizen*, 11 November 1990.

(37) Hugh J. Gaylor, *Land-Use Conflict and Sustainable Agriculture on the Rural-Urban Fringe*, Brief presented to the House of Commons Standing Committee on Agriculture, 21 October 1991, p. 3.

(38) D.W. Anderson, C.J. Roppel and R.M. Gray, *Sustainability in Canadian Agriculture*, Paper prepared for the Science Council, August 1991, p. 35.

increasingly difficult for Ontario producers to compete. A regional plan that has been in place since 1981 is threatening to come unstuck. The *Food Land Guidelines* issued by the Ontario government in 1978 advised municipalities on the designation of agricultural lands in their official regional plans. In the Fruit Belt, agricultural zoning protected good growing areas and redirected development to the poorer agricultural lands south of the Niagara Escarpment. This approach worked reasonably well when development pressures were not intense and agricultural prices kept up the value of the land reserved for agriculture. As discrepancies between agricultural and developmental land values grow, however, preserving the land is not preserving the farmer. Many farmers are now financially unable to work their land and are seeking to sell off some parcels in order to continue farming the remainder. In a move to help farmers, the Niagara Region Council voted in the fall of 1991 to allow such sales, but the plan was blocked by the provincial government in an effort to protect the declining farmland base.⁽³⁹⁾ Locking farmers into a lifestyle they cannot afford does not appear to be a long-term solution.⁽⁴⁰⁾ This is one of the problems of agricultural land zoning since it restricts the use of the land without compensation.

Another solution being promoted in the Niagara Fruit Belt is resort to conservation easements. This provides the farmer with compensation, an essential part of any zoning solution. The idea is that the farmer receives compensation for development restrictions placed on his land. While this may work out to less than fee simple, it may represent a large percentage of this value. Under such an arrangement, the farmer voluntarily sells the development rights to land to which he or she retains title. The conservation easement runs with the land either in perpetuity or for a specified period of time. Farmers can use the money to pay down debt, reinvest in the farm, or for other purposes. They can even sell the land, although its use is limited to farming and open space.⁽⁴¹⁾

Such a purchase of development rights to preserve farmland and open space has been used in nine U.S. states with moderate success in protecting agriculture in urban fringe areas. Advantages of the scheme are its fairness to farmers and its potential for long-term

(39) Canadian Press Release, 31 January 1991.

(40) Gaylor (1991), p. 6.

(41) Thomas L. Daniels, "The Purchase of Development Rights — Preserving Agricultural Land and Open Space," *Journal of the American Planning Association*, Vol. 57, No. 4, American Planning Association, Chicago, Autumn 1991, p. 421.

preservation of vulnerable farmland. Disadvantages are its cost, administrative cumbersomeness, and the fact that it is voluntary.

It is clear that at some stage there will have to be a decision in this country as to whether agricultural land warrants saving; if so, in order to preserve it, effective instruments will need to be developed. Even though local authorities must ultimately take the measures to keep land in production, the issue will have to be resolved at the national level. It is not just a case of preserving fertile land, but rather the general issue of food policy and the priority placed upon food security. The production of food and fibre is an irreplaceable activity and demands a predictable future.⁽⁴²⁾

A pertinent example is the outcome of the extensive purchase of farmland to build Mirabel Airport. In 1969, when Mirabel was proposed, 38,900 hectares of land were expropriated for the construction of the airport and its adjoining industrial park. Most of this land consisted of Class 1 and 2 soils. Over 10 years, 32,800 hectares were eventually returned to various individuals and municipalities. It is estimated that about 75% has returned to agricultural use because agriculture remains the most viable economic activity. In retrospect, it can be seen that the decisions that took this land out of farmers' hands and made its future uncertain for so many years, were not able to offer any more viable economic solution; moreover, they took so long to resolve that they very likely contributed to the detriment of the quality of the land base.

It is interesting to note that at about this time the Quebec government introduced legislation to protect agricultural land. Land use pressures, notably within the Montreal-Quebec corridor, led that government in 1978 to pass the *Provincial Act to Preserve Agricultural Land*. It restricted the non-agricultural development of land within designated agricultural regions. Three thousand hectares of land returned to agricultural production following passage of the bill.⁽⁴³⁾

Agriculture itself sometimes has negative impacts on adjoining land. To control these impacts and to protect farmers from nuisance claims for any odour, noise or dust resulting from normal farm operations, three provinces have enacted protective legislation. In Nova Scotia, Ontario and Quebec, legislation provides for dispute settlement, where disagreements arise over the impacts of farm operations.⁽⁴⁴⁾

(42) Agriculture Canada and Alberta Agriculture, *Sowing the Seeds for Sustainable Agriculture*, Vol. 1 and 2, Proceedings of the Travelling Symposium, 11-16 February 1991, p. 1.

(43) Anderson *et al.* (1991), p. 36.

(44) For example, Ontario's *Farm Practices Protection Act*, of 1988.

Other land use conflicts have no such mechanisms for dispute resolution and yet they can be equally difficult to resolve. Each year, farmers play host to hordes of hungry migratory waterfowl, which cause millions of dollars in damages as they head to their winter or summer abodes.⁽⁴⁵⁾ Farmers, in their turn, modify the rural landscape in ways that have impacts on wildlife, as they co-opt marginal land for production and drain wetlands to facilitate cropping.⁽⁴⁶⁾ Often, this is the result of policies that encourage production at the expense of retaining wetlands and grasslands. The area being farmed in the Prairies, for instance, is reported to be over four times that cropped at the beginning of the century. The wheat area alone has almost doubled since 1950, and total agricultural land has increased by almost 50% since 1970.⁽⁴⁷⁾

The U.S. has used a number of acreage reduction and conservation programs to reduce production on erodible soils and protect fragile wetlands. Conservation measures are a prerequisite to receiving support payments for expanded or marginal production areas in the Sodbuster and Conservation Compliance programs. Farmers also lose the benefits of support payments when they convert wetlands to agricultural production. A voluntary program, the Conservation Reserve, places qualifying land into permanent, soil-conserving grass and trees for a 10-year contract period. Payment is per acre on a bid basis, and owners are responsible for maintaining the conservation cover at their own expense, although certain types of recreational leases are permitted. The program even covers buffer strips along waterways.⁽⁴⁸⁾

A program modelled on the Conservation Reserve Program has been developed in the Canadian Prairies. The Permanent Cover Program encourages the replacement of cash crops by cover crops. Under this program, landowners can bid for a one-time payment to convert cropland to permanent cover. Bids for 20-year commitments are in the order of \$40 an acre, with another \$20 or so for seeding costs. The Prairie provincial governments also offer habitat incentives through their wildlife agencies, which are generally richer than the federal program,

(45) *Western Producer*, 21 November 1991, p. 7.

(46) John Girt, *Common Ground*, A Report commissioned by Wildlife Habitat Canada, 1990, p. vi.

(47) *Ibid.*, p. 4.

(48) Council for Agricultural Science and Technology (CAST), *Ecological Impacts of Federal Conservation and Cropland Reduction Programs*, Report No. 117, September 1990, p. 5.

but always below the agricultural value of the land.⁽⁴⁹⁾ Such programs are wildlife-oriented rather than designed to support integrated land uses.⁽⁵⁰⁾

To be more effective, these programs would have to be designed to facilitate cropland changes and to provide permanent protection unrelated to fluctuations in commodity prices. As long as other policies pay more to keep the land in production, these environmentally protective policies will not have much impact. They appear to provide a greater incentive to low-income producers, offering an alternative to crop production as an economic opportunity for the land.⁽⁵¹⁾ Nevertheless, farmers need an indication from governments that agricultural land has value not just to produce food but also to safeguard our natural resource heritage, whether it be wildlife or soils.⁽⁵²⁾

Practices to protect wetlands or control pests and weeds on land set aside from production will not be widely adopted by landowners unless they are easy to implement, inexpensive, consistent with other farm practices, or require little maintenance and monitoring. Innovative research and extension methods will enhance adoption and success of good management programs. The next section looks at this aspect.⁽⁵³⁾

HOW IMPORTANT IS TECHNOLOGY IN IMPLEMENTING SUSTAINABLE AGRICULTURE?

Technology transfer is here defined as the application of scientific knowledge (education and research) to agriculture in order to fill desirable national goals, for example, competitiveness, environmental sustainability and food self-sufficiency. This is broader than the traditional interpretation, in which the term refers to the transfer of technology from a company or a country for commercial use elsewhere. It is seen here as development, communication and

(49) Girt (1990), p. 32.

(50) *Ibid.*, p. 42.

(51) *Ibid.*, p. 34.

(52) *Ibid.*, p. 7 and 38; and Carole Giangrande, "Agriculture and Sustainable Development," *The Guelph Seminars of Sustainable Development*, S.G. Hilts and A.M. Fuller, eds., School of Rural Planning and Development, University of Guelph, Guelph, 1990, p. 56.

(53) CAST (1990), p. 1.

implementation of technological advances primarily in the form of research, but also of demonstrations and other technology initiatives.⁽⁵⁴⁾

Total annual expenditures on Canadian research and development for the agriculture and food sector are reported to be approximately \$595 million, of which just over \$156 million go to technology transfer.⁽⁵⁵⁾

A very elaborate system of over 400 committees oversees research and development for the agriculture and food system. It covers regional and commodity interests and performs a watchdog and information function. Membership appears to be largely determined by position and is drawn from researchers, extension personnel, industry and producers or commodity groups. While producers are members, however, their numbers are reported to represent only approximately 4%.⁽⁵⁶⁾

A useful part of the information exchange system is a data base, in existence since 1974, which consists of all the more than 4,400 R&D projects carried out by government, industry and the universities in this country.⁽⁵⁷⁾

Since 1974, the principal coordinator of all this information has been the Canadian Agricultural Research Council (CARC), a body at arm's length from the federal government, which monitors the adequacy of agricultural research in Canada and fosters the development of a viable agri-food industry that can meet Canada's domestic and export needs. CARC reports its findings to the Canadian Agriculture Services Coordinating Committee (CASCC), which has been functioning since 1932 as the focal point for agricultural research in Canada. According to its Chairman, the Deputy Minister of Agriculture Canada, "CASCC has consciously addressed its way of doing business in order to keep up with the demands of agriculture."⁽⁵⁸⁾

It is natural that the Deputy Minister should be so closely involved with this research committee system, since Agriculture Canada is the largest supporter of research and development in this country, contributing just under half of the funding involved. Functions that

(54) Canadian Agricultural Research Council, *Partnerships: A Focus on Technology*, Conference Proceedings, Montreal, 4-5 June 1991, p. 49 and 58.

(55) McEwen (1991), p. 4.

(56) *Ibid.*, p. 12.

(57) McEwen, *ibid.*, p. 10.

(58) CARC, p. 3.

might be considered pivotal to sustainability (soils, management, agro-meteorology, environmental quality) are reported, however, to receive only 22% of total research effort.⁽⁵⁹⁾ Omissions are said to include the biological and social sides of agriculture. There are virtually no studies that take a systems or an agro-ecological approach, or relate types of farm practices to their environmental impacts. Baseline data on soil, water, air and food are reportedly not yet complete enough for us to measure and monitor our progress,⁽⁶⁰⁾ although the Research Branch of Agriculture Canada is in the process of establishing a sophisticated information system, which, over the next few years, will fill existing gaps.

According to a paper commissioned by the Science Council of Canada as part of its own sustainable agriculture study, management studies within the agricultural research establishment tend to be single-commodity or production-oriented. Even economic information about environmental sustainability practices is lacking. Finally, the crucial role of the family farm in the viability of rural communities and the broader social and ethical issues connected with agriculture⁽⁶¹⁾ appear to fall outside the mandate of the agricultural research community.⁽⁶²⁾

It has been suggested that historical reductionist approaches do not lead easily to an integrated research system. Without knowledge of a system that ensures sustainability, it is very hard to gauge whether research being done in isolation is actually supporting a sustainable approach.⁽⁶³⁾

The federal government's role has been described⁽⁶⁴⁾ as being to create the environment in which researchers can generate new information and then translate it into a form that will enable extension agents to understand fully its approach and application. This information must be able to be understood and used at the farm level, an approach that has been described as the "bench to barn" approach.⁽⁶⁵⁾ If scientists were more involved in the delivery of basic research, this would probably be more likely to happen. Evidently, in the U.S. extension is tied much more closely to college R&D. It is suggested that more co-operative ventures between

(59) McEwen (1991), p. 15.

(60) CARC (1991), p. 61.

(61) *Ibid.*, p. 62.

(62) McEwen (1991), p. 16-17.

(63) *Ibid.*, p. 21.

(64) CARC (1991), p. 48.

(65) *Ibid.*, p. 54.

the federal government and the universities here could likewise ensure that basic research is not piecemeal and is moving towards a systems approach. A caution should be added, however, that regional differences are important and must be considered.

Regional differences are significant across the country and will have to be addressed in terms of priorities and planning of research. Farmers need more understanding of local environmental conditions so that they “can integrate their cropping practices in such a way as to take advantage of the resources nature provides and can behave as good stewards.”⁽⁶⁶⁾ Sustainable agriculture requires high levels of management skills and an intimate knowledge of available resources, obtained through both experience and training. The Science Council suggests viewing research extension and implementation along a continuum as being an appropriate and sustainable approach.⁽⁶⁷⁾ If the research system operates in this way, it will be much easier to generate a two-way information flow to ensure that the technology transferred is appropriate.

WHAT IS THE ROLE OF GOVERNMENT?

The federal government has developed criteria to assess whether existing policies and programs diminish the long-term capacity of renewable resources to meet future food needs. This implies encouraging farming technologies that conserve the natural resource base, promote diversification and crop rotation, minimize air and water pollution, make use of environmentally safe pest control strategies, minimize land use conflicts and the use of marginal lands, and help preserve genetic resources.

It follows that new policies and programs should be designed and delivered to take into account the on-farm and off-farm environmental costs. In this way, environmental sustainability will be built into new government approaches. The federal government appears to be using the new safety net programs as tests of this approach. The enabling legislation for the two programs, GRIP (Gross Revenue Insurance Program) and NISA (Net Income Stabilization

(66) Science Council of Canada Committee on Sustainable Agriculture, *Sustainable Agriculture: Some Policy Concerns*, A Paper prepared for a workshop co-sponsored by the Canadian Agricultural Research Council, Sidney, B.C., 29 August 1991, p. 21.

(67) *Ibid.*, p. 20.

Account), calls for environmental assessments to be carried out within two years of a federal-provincial agreement's coming into force.⁽⁶⁸⁾

In an area of concurrent jurisdiction like agriculture, such a direction calls for a co-operative response. The Federal-Provincial Soil and Water Accords have been identified as a means of managing the land base in a sustainable way. If the Accord Management Committees could be broadly structured in representation and focus, they might then be in a position to coordinate the activities needed to ensure sustainable approaches.

Input from the producers themselves is crucial to this process since making productivity and environmental sustainability compatible is dependent on the skills of farmers.

It is government, however, which sets the policy framework for a stable industry.⁽⁶⁹⁾ By its support and education and regulation policies, government collectively gives a signal to industry about its goals, which are too often set at the expense of long-term resource conservation and environmental management.

Historically, Canadian agricultural policies have concentrated on the economic feasibility of Canada's farming. Production subsidies have provided incentives to expand, mechanize and specialize for competitive purposes.⁽⁷⁰⁾ Practices have been encouraged which have contributed to the degradation of our soil and water. Programs have linked benefits to the volume of commodity produced. This has tended to reduce the risk of specialization and encouraged the use of inputs.

All levels of government have tended to support the market-competitive approach, pressured by producer associations which have been effective policy advocates and attracted wide government support.⁽⁷¹⁾ The national universal programs have discouraged activities (e.g., conservation) that could drive up production costs over those in another province. Though provinces have the wherewithal to offer local inducements to ensure sustainability, especially in view of their jurisdiction over land use, and management of water, air and soil, like

(68) Agriculture Canada, *Building Partnerships, Growing Together*, September-October 1991, p. 3.

(69) Federal-Provincial Agriculture Committee on Environmental Sustainability, *Report*, p. 33.

(70) Grace Skogstad, *Political Institutions and a Sustainable Agriculture*, University of Toronto, 1991, p. 4.

(71) *Ibid.*, p. 8.

the federal government, they have been more concerned with risk protection and other safety nets.⁽⁷²⁾

Since the prime responsibility for the environmental aspects of agriculture falls to the provinces through their regulation of public lands, property rights and municipal affairs, the main federal power within a province is through use of its spending power to provide incentives and services that promote environmental sustainability.⁽⁷³⁾ The federal government can also exercise powers in interprovincial and international matters; traditionally, it has also assumed primary responsibility for research. The provinces' jurisdiction over education makes them responsible for disseminating the results of that research to producers.⁽⁷⁴⁾

Soil and water resources have been treated customarily as a matter of shared, rather than provincial, jurisdiction, perhaps because they are a vital part of agriculture and also because initial cooperation dates to the 1930s and disaster relief, always a federal responsibility.⁽⁷⁵⁾ The federal and provincial government tend to work with each other and with farmers on resource projects at the individual farm or regional level. Good examples of such cooperation are SWEEP (Soil and Water Environmental Enhancement Program) and the Land Stewardship Program in Ontario, both of which address local problems.

SWEEP is designed to improve soil and water quality in southwestern Ontario by reducing phosphorous loading in the Lake Erie basin from cropland runoff, and arresting soil erosion that contributes to water pollution. The federal government researches, develops and evaluates the technology, and gives technical assistance to farmers. A federal-provincial committee of agricultural and environmental representatives manages SWEEP.

The present Land Stewardship Program is a four-year, \$38 million initiative to encourage conservation. It gives financial assistance to farmers for conservation practices, research, courses and programs, and is administered by the Ontario Soil and Crop Improvement Association, a private organization to which the Ontario Government delegated the task.

The apparent success of and participation in these programs suggest that the constitutional and institutional framework is not a barrier when both levels of government are

(72) *Ibid.*, p. 11.

(73) *Ibid.*

(74) *Ibid.*, p. 12.

(75) *Ibid.*, p. 13.

committed to remedial action. Indeed, land management and land zoning issues, and reform of municipal assessment and taxation policies were all discussed by the Federal-Provincial Committee on Environmental Sustainability, reinforcing the fact that constitutional delineations of authority are not obstacles to agro-environmental policy reform.⁽⁷⁶⁾

The definition of sustainable agriculture adopted by the Federal-Provincial Agriculture Committee on Environmental Sustainability embodies the dilemma facing today's agriculture.⁽⁷⁷⁾ To be sustainable, agriculture must be at one and the same time economically viable for the present generation of farmers, and environmentally sustainable for future generations. This adds a long-term dimension to the present generation's planning, and it changes the uni-dimensional economic focus into one that integrates environmental and possibly even social objectives.⁽⁷⁸⁾ The report does not offer any guidance as to how short-term economic viability may be reconciled with long-term conservation.

It is clear, however, that farm practices are becoming suspect if they appear to impinge on society's goals of high quality, safe food, and a clean environment, free of ground and surface water contamination. Increasing pressure is likely to be placed on the present generation of farmers in the name of their descendants. Farmers are now being held responsible not only for on-farm impacts but also for off-farm land and water degradation. Today's farmers are saying, however, that they cannot afford to carry out some of the remedial measures required to build up the natural resource capital base.

It will fall to government, therefore, to give more priority to environmental and social elements by introducing policies and funding to assure a new balance between economic, social and environmental claims. Governments must share some responsibility for encouraging the production-driven farming practices that have contributed to our present environmental state.

The federal government has already indicated its intention to integrate environmental, economic and social factors into its safety net programs.⁽⁷⁹⁾ An economic dimension is also being added to environmental research programs. Trade-offs will, however, be inevitable.

(76) *Ibid.*, p. 17.

(77) Federal-Provincial Agriculture Committee on Environmental Sustainability (1990), p. 11.

(78) *Ibid.*, p. 3.

(79) House of Commons, Standing Committee on Agriculture, *Minutes of Proceedings and Evidence*, Issue No. 7, 8 October 1991, p. 5.

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