SUSTAINABLE DEVELOPMENT AND AGRICULTURE*

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The purpose of this paper is to address what appears to remain a very basic issue in the debate on sustainable development--what is "sustainable development?" The term has become a catch-word in the literature, in the media, and in public pronouncements by politicians, bureaucrats, scientists and many of the public at large. It is not at all clear that the term has achieved a level of meaning which allows reasonable communication among users. As the term is applied to agriculture--our major interest in this paper--the set is also broad, and often conflicting. We do not purport to resolve this important and basic issue in this paper. We will review several definitions that appear in agricultural and/or agricultural economic literature. Then we will identify what we believe to be several required conditions--necessary conditions in economic terminology--for positive progress toward "sustainable development." Although our examples are drawn from agriculture and the resource areas, and from food production, we suggest these necessary conditions are general enough to be applied more broadly to most development.

We will argue that sustainability is composed of a set of five socio-political pressures, of which the most important is political. It is also intimately tied to economic growth. We will argue that preservation of the environment cannot be treated in isolation of other public

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pressures, in other words, sustainability in development involves trade-offs. We argue that there are fundamental differences between developed and developing countries in achieving sustainability, although the political factor is dominant in both.

Finally, we will argue that as scientists attempting to contribute to a more sustainable condition of any industry, that we will have to increasingly deal in the framework of system analysis.

These are all very constraining factors on the role of university people, or of researchers, as we seek to contribute to this important global issue. These characteristics suggest a milieu in which we may be poorly equipped. Importantly, it is a view, or analysis, of sustainability that does not appear to have been addressed in any systematic way.

Recognizing that we may be misinterpreted in our message, as economists often are in inter-disciplinary debates, let us state the case in alternative terms: although the implications are really very serious, and in many ways beyond the influence of researchers in the sciences, achievement of sustainability in development is first and foremost an issue of politics and political priorities; in developed and developing countries alike, although for different reasons, significant progress on sustainability in agriculture or any other sector will not be made until political forces are able to raise this longer-run issue above the priorities of short-run demands. As scientists, we should understand that resolution of any problem is dependent upon the quality of definition of the problem. If we are close in our 'problem definition,' a significant dimension has been contributed to understanding where some of our research and communication effort will have to be directed in order to achieve the illusive goal of "sustainable development."

Definitions of Sustainable Development in Agriculture

This section reviews several definitions of sustainable development and relates them to the agriculture sector. The scope is extremely broad, ranging from limited input agriculture (which to some analysts and organizations means 'organic farming'), to the relationship between the environment and economics, and to the common sense (but non-operational) definition provided by the Brundtland Commission.

Low Input/Sustainable Agriculture (LISA)

In 1987, the U.S. Congress funded a new research and education program within the U.S. under the 1985 Food Security Act. In 1988 the program became known as the "Low-Input/Sustainable Agriculture Research and Education Program" or LIFSRE. Fortunately, the vernacular has evolved to LISA. Madden (AJAE, December 1988) indicates that low input/sustainable agriculture encompasses a wide array of approaches to farming that reduce dependence on purchased inputs, reduce environmental hazards and maintain the basic agricultural resources, land and water. The LISA program in the U.S. is significant in that it recognizes:

1. that if a farming method is not profitable, it cannot be sustainable (we will refer to this characteristic later as a micro economic, necessary conditions);

2. that research is required on farm management, enterprise risk, soil and water quality, human health risks, and other ecological implications of low input strategies.

These are significant requirements for a program which was allocated $3.9 million in 1987; several universities in the U.S. have undertaken research and education programs.

Organic Farming

Dr. Stuart Hill of Macdonald College (an entomologist) provides another version of sustainable agriculture. He says in part:

> Sustainable agriculture is both a philosophy and a system of farming ... sustainable agriculture systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, appropriate mechanical cultivation and mineral bearing rocks to maximize soil biological activity, and to maintain soil fertility and productivity. Natural, biological and cultural controls are used to manage pests, weeds, and diseases ... We can no longer go on pretending that the energy-dependent, environmentally descriptive systems of the past can be passed off as sustainable agriculture ... Even a small loss (in the resource base) would make the system unsustainable. (Cooperator, February 8, 1990)

According to Hill, sustainable agriculture means organic farming; resource and environmental degradation are irreversible; achieving sustainability is an absolute process; there are no trade-offs.

In regards to organic farming, it may be interesting to note that this farming method already exists in Canada on a commercial basis for many food items. For over a decade, commercial distribution of "organic food" has occurred and we have seen imports and exports of "organic" foods. Despite this commercial activity, it is interesting that organic food have no status in Canada from a food safety, quality or certification standpoint. The regulatory framework has not yet caught up to the commercial market. As we discuss later, this says something about political will to act in this new area.

It is also interesting to note in the context of both LISA and organic farming that terminology such as the following is used to describe appropriate farming practices or methods:

- exotic natural enemies
- integrated pest management

- mechanical and rotational weed control
- whole farm management systems

Lynam and Herdt in a September 1988 paper prepared for the Rockefeller Foundation, *Sense and Sustainability: Sustainability as an Objective in International Agricultural Research*, point out that for sustainable agriculture: (1) research needs rise; and (2) farmer knowledge and management will likely increase relative to conventional "high input" technology.

These arguments appear in the context of technology referred to as low input agriculture! In the same context, one must ask the question about the applicability of these concepts to food production in developing countries. Clearly a country which cannot meet its food needs using existing resources and technology cannot, ceteris paribus, be expected to devote the additional national resources to achieve so-called low input/sustainable agriculture food production.

There are many contradictions in terms, and in conditions, that must be resolved to achieve sustainable food production.

The Brundtland Commission

The United Nations established the World Commission on Environment and Development in 1986. Its report, commonly referred to as the Brundtland Report is responsible for the term "sustainable development." The concept, intuitively appealing and eminently reasonable, unfortunately is lacking in operational significance--"sustainable development is development that meets the needs of the present without compromising the ability of future generations." It is a concept with which few can disagree, but so open ended

that the definitions range across the map. We have precedents for such concepts in North America--"orderly marketing," the "family farm" ...

The Province of Manitoba appears to have embraced the concept as closely as any province in Canada. The Premier's contribution to facilitating our task of finding an operational definition is the following:

> In simple terms, sustainable development means development without destruction; growth in harmony with our environment, preserving our resource base for our economic well being and planning for our children's future. (Agenda, Premiere Issue, December 1989)

In keeping with its commitment to sustainable development, the province established the Manitoba Round Table on Environment and Economy in 1988, and has continued to negotiate with the Federal Government for the World Centre on Sustainable Development, announced by the Prime Minister before the United Nations in October 1988. The province certainly manifests awareness of the sustainable development issue. It is not, however, without the critics in terms of positive action, and examples can be found of action which would appear to contradict some aspects of sustainable development.

The significance of the Brundtland and Manitoba concepts of sustainable development is: (1) the emphasis on economies and the environment; and (2) the lack of focus creating an "all things to all people" connotation.

An Agricultural Economic Interpretation

Veeman, an economist from the University of Alberta, provided a thoughtful and penetrating discussion of "*Sustainable Development: Its Economic Meaning and Policy Implications*" at the AIC National Conference in Montreal, July 1989. Veeman is known for his skills in resource economics as they apply to agriculture, but he has published on water

and energy as well. His thesis is that the debate on sustainable development is valuable because it is causing economic and social policy to be assessed in terms of growth, distributional and environmental considerations. Sustainable development is, therefore, a constraint to be imposed on public policy determination and to be used in policy and program evaluation.

Whereas the conventional wisdom holds that growth is a cause of environmental problems, Veeman argues that growth is a critical component in (achieving) sustainable development. He distinguishes between developed and developing countries: in rich countries, poverty exists and reducing resource destruction costs money--redistribution of income is easier if national income is growing; in developing countries, the standard of living of the masses cannot be raised without increased productivity and output in agriculture, other industries, and the service sectors. The distribution dimension of sustainability is what distinguishes economic growth from economic development. Growth is a necessary but not sufficient condition of development. Absolute poverty and hunger have to be reduced in order to achieve development. A further distributional issue raised by Veeman is that of "intergenerational equity" -- the question of renewability of resources, and of avoiding irreversibility in resource use.

On his environmental component, Veeman observes "the practical issues are whether economic growth processes are ecologically and environmentally sustainable over time and whether they are imposing undue (and especially) irreversible environmentally related costs on society. For public policy purposes, the natural resource base (particularly for energy and materials) is not fixed, but is evolving and changing as a consequence of technology, substitution and institutional change.

This discussion is, in our view, a valuable and essential contribution to understanding what is and what is not "sustainable." In accepting much of Veeman's thesis, we may be captured by disciplinary bias. However, as he quite correctly observes, sustainable development, and sustainable agriculture, are public policy issues. They, therefore, must be analyzed from that standpoint. The only weakness in Veeman's paper is limited discussion of the political component. This component will be developed in a later section of this paper.

Characteristics of Sustainable Development

Sustainable development, whether in agriculture or some other sector, is a public policy issue. The concept was generated in that context, the discussion generated by the concept is a public policy debate, and any significant action in a global, national or regional context will occur in the form of public policy. Certainly sustainable development has other dimensions--economic growth, the environment, physical relationships and technology, social considerations, perhaps others--but these considerations are all part of the public policy process. It is not a new process: for example, many of the issues being discussed today in Canada were identified at a Conference in Montreal in 1961 (Resources for Tomorrow; a Conference which examined resource management problems of agriculture, water, regional development, forestry, wildlife, recreation and fisheries). What is new is the title--sustainable development--and the level of public awareness of the problems, as measured by polls, the media and political pronouncements. Positive action is a different story.

In our view, sustainability has much to do with the ability of today's citizens of the planet Earth to grow, to develop, and to prosper without reducing the ability of future generations to do the same, particularly from the environmental standpoint. To achieve this goal in agriculture will likely require increased LISA-type farming technology, it will likely

generate increases in organic farming and food production, and will undoubtedly see whole system, environmentally compatible production such as the Mombassa-Bamburi quarry project in Kenya identified in the last section of this paper. But most importantly, in the foreseeable future we will simply have to do a better job of things we are already doing because inertia, the lack of resources in many countries (including Canada) and the lack of "sustainable" technology are constraints to rapid or significant change. Consequently, sustainability in development is a process of compromise and trade-offs, which depend significantly, if not most importantly on political forces and political priorities. The trade-offs will occur among the following two sets of factors:

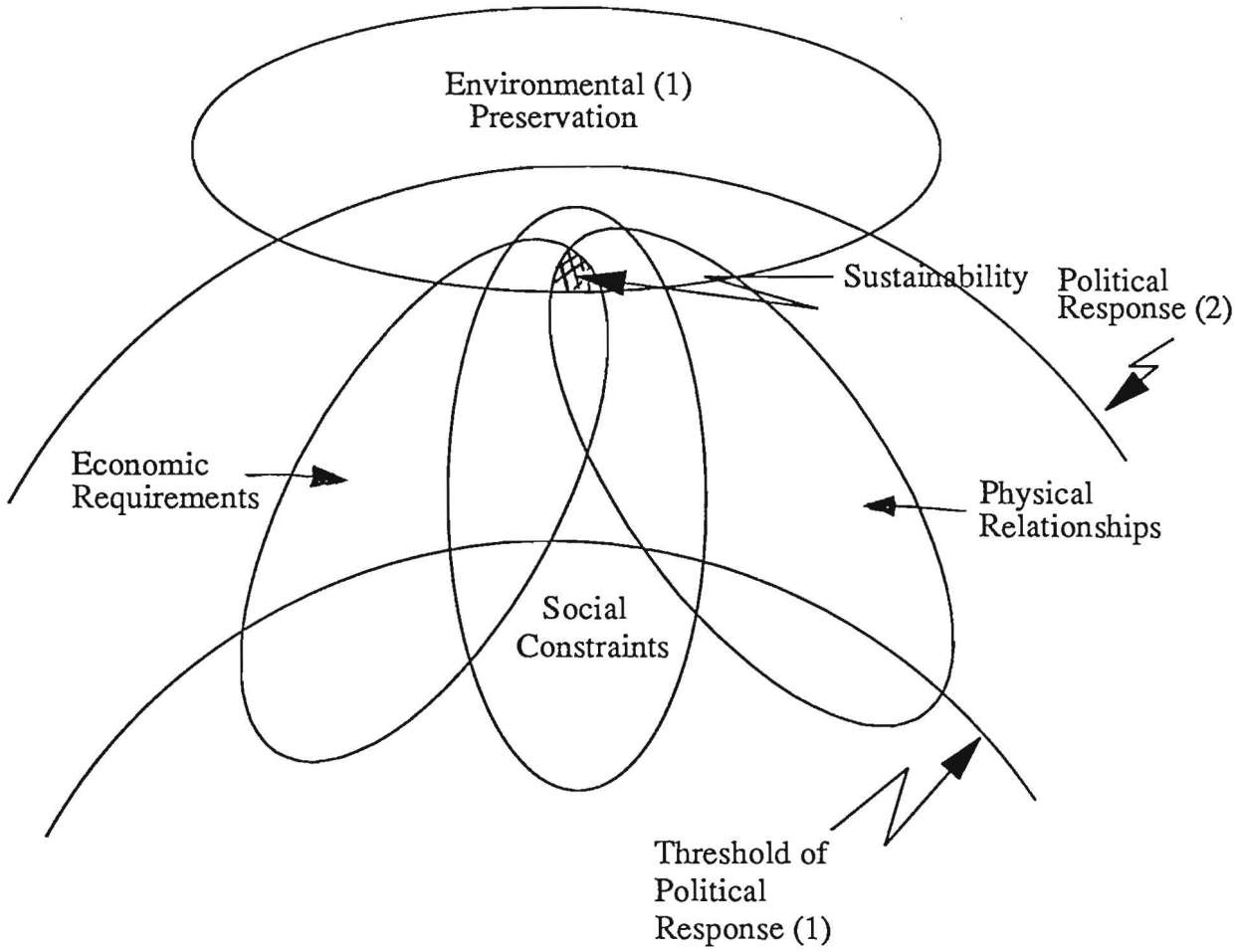
1. environmental, economic, social, technical and political pressures; and
2. today and tomorrow.

This concept of sustainability, and the implied difficulty of achieving it, is characterized in Figure 1. Economic, social and physical requirements must be combined to produce today, and preserve the resource base and environment for production tomorrow. Physical relations reflect the state of technology, which Veeman has quite correctly identified as an important variable for change; they are also a source of uncertainty over time. Social constraints have to do with how society is organized and in the end, which trade-offs are acceptable and which are not. Economic requirements mean that an activity (food production) be profitable in an investment sense--the micro consideration--and be socially profitable in the long run (the macro-economic consideration). In an entrepreneurial world both micro and macro-economic conditions must be met.

These are stringent conditions in achieving sustainability; they are interdisciplinary; they involve major uncertainties, the most important of which is knowledge of the future. It is understandable that sustainability is an illusive concept.

Figure 1

Requirements for Sustainability



Source: Adapted from C.A. Carter, N.D. Frank and R.M.A. Loyns, Wheat in African Development: The Case of Tanzania

But these are also the easy dimensions of sustainability; the problems lie on the political side.

Figure 1 also indicates that sustainability requires achieving a threshold of political response that encompasses the mutually compatible aspects of the other four components, i.e., political action which accommodates the other requirements. Since virtually all of sustainable development will involve some aspect of public administration, political action translates into laws, regulations, a bureaucracy and funds. That takes time, probably a long time for big projects. But the significance of Figure 1 is clear: sustainability is unlikely to occur in the absence of political will and political/bureaucratic action.

To illustrate the process of change in a political setting consider the following. Political change usually originates with an active minority identifying a problem, and verbalizing it. Over time, public awareness increases, the media becomes involved because the public awareness sells copy, political pressure may be generated, and a few politicians may pick up the cause. Subsequently, political awareness becomes more general, party platforms reflect the issue and political pronouncements are made. This phase may include research, commissions and promises as politicians buy time. But all of this process has little meaning until two critical additional steps have been taken. First, legal and regulatory basis must be established--the statutory phase; and a budget must be set up and a bureaucracy created to research, regulate and police. It is the last phase that is the action phase. The process of sustainability is likely somewhere between the political awareness phase and the statutory phase in most developed countries. In Canada we are, at most, in the political awareness phase.

In the hungry nations of the world, sustainability is only one of many other conditions of aid, imposed by donors, which recipients have learned to live with. What we are saying is that the action phase has not yet been reached in most countries, particularly Canada, and in developing countries it is an issue only from the outside, because other priorities are more important.

There are a number of important conclusions that are drawn from, or relate to this way of defining sustainability.

1. Figure 1 demonstrates that a set of at least five major socio-political and technical forces must coincide to achieve sustainability--this characteristic implies extreme difficulty, delays, and information requirements to achieve the goal.

2. Political response (awareness, power, commitment, and ACTION) are required to accomplish sustainability. This is considered to be the most critical component. On this point, recall the election hype in 1988 in Canada on the environment, and the appointment of M. Bouchard, a personal envoy of the Prime Minister as Minister of the Environment. Compare this awareness level with the article in the Globe and Mail (February 2 - attached) which indicates that the promised environment initiatives probably will not be funded in the new Budget.

We suggest a corollary exists as well: there are, and will be, many situations and projects which do not meet other important requirements for sustainability, but that will be sustained indefinitely by political will alone. This corollary has been criticized on grounds that if a project does not have, for example a sound economic basis, political will will ultimately change. Is sustainability forever, or does it have a time frame? There are many examples of projects and economic systems that are maintained at enormous cost to other

objectives--the political will may ultimately change, but the damage has been inflicted. As well, some processes are partly or largely irreversible. In important respects the Common Agriculture Policy of the Economic Community fits this description; the failure of Canada to control the growth of its national debt may be another example.

3. Sustainability is a public policy issue and therefore trade-offs will be made. This suggests that the model and the neat overlapping in Figure 1 which identifies "sustainability" will in fact have elastic boundaries. What may be acceptable in an individual disciplinary sense will have to accommodate other disciplines and the political process. On the other hand, an absolute approach to sustainability as suggested by some (the entomologist: organic farming is sustainable agriculture) is itself unsustainable. All of this is not to say that the separate disciplines, and absolutism, may not have an important role in any final solutions (for example, in defining problems, identifying research requirements, producing and communicating research results), but this will feed in to resolution in some form of interactive, i.e., systems framework.

Picking up on Veeman's intergenerational transfer issue, Canada has an important intergenerational problem with the national debt. It is a valid question as M. Bouchard has found, to ask where new funding will come from, and what existing programs will be cut to finance environmental initiatives? Provinces are in the same situation. The other alternative is increased taxation, decreased consumption--are Canadians that committed?

4. All of the above indicates that sustainability is an issue of priorities. This has extremely important implications for understanding how, and where, sustainability has the most likelihood of success. It is likely to be a serious issue and to achieve positive action only in

countries wealthy enough to be able to meet basic needs and have some measure of "discretionary income."

This term (discretionary income) is another area which has important micro and macro connotations: the term "discretionary income" was originally applied to households which are able to meet their basic (low order) needs of food, clothing and shelter and still have a surplus to allocate toward meeting higher order needs. If households are continuously hungry, or cold, they are unlikely to be motivated to preserve the fish supply, the soil resource or the trees because the drive to meet basic needs is stronger than the will to conserve. Similarly, countries with massive foreign debt and a foreign exchange crisis often deal with these problems at the cost of their consumers and of their resource base. Nations with some fiscal discretion are more likely to allocate funds to resource conservations. This form of behaviour and the institution they generate have an important analogue in consumerism. Wealthy nations serve consumer rights reasonably well; underdeveloped countries ignore them.

In both the micro and the macro case, the manifest behaviour is in important respects perverse. It is the hungry consumer and the debt ridden nation that most need the resources because they have no alternatives; wealthy nations have some options in squandering opportunity. But the priority of survival dictates the reaction, and sustainability loses.

5. Related to the above, sustainability is an issue of development. Veeman argued that in Third World Countries growth is required to raise the standard of living; in some countries, growth in the form of agricultural output is required simply to feed people. The implication is that sustainability cannot be achieved without significant growth and redistribution of the benefits of that growth. Some environmental degradation may be required to achieve that growth.

Developing countries and developed countries appear to be very different in this characteristic. In developed countries, misuse of the environment may be a product of development, as the standard of living is too high. In economic terms this implies that the social discount rate on intertemporal resource allocation is too low. But wealthy countries have an advantage; rechanneling of funds from the development process is a means to maintain the environment and the resource base, and in the longer term perhaps moving toward an equilibrium because the redistribution of funds may reduce living standards. Developing countries do not have this fiscal latitude.

6. Environmental and resource degradation are sometimes reversible. In the context of trade-offs, uncertainties and priorities, it is fortunate that not all resources are non-renewable, and that technology provides some opportunities to reverse previous mistakes. This characteristic is not an argument for misuse of resources but it provides a further argument against absolute preservation of the resource base.

The Great Lakes are coming back; we are told even the Red River is cleaner than it was a decade ago; Red River Valley soils are probably more productive today in a natural context than they were two or three decades ago. These are important examples of three resource situations which were badly misused (perhaps still are), but which have been redeemed to a significant degree. None of these resources will ever be returned to their natural state, but that is not the issue. They have regained lost productivity, they show signs of improving productivity into the future; these resources will be available for future generations. We expect many similar examples can be cited.

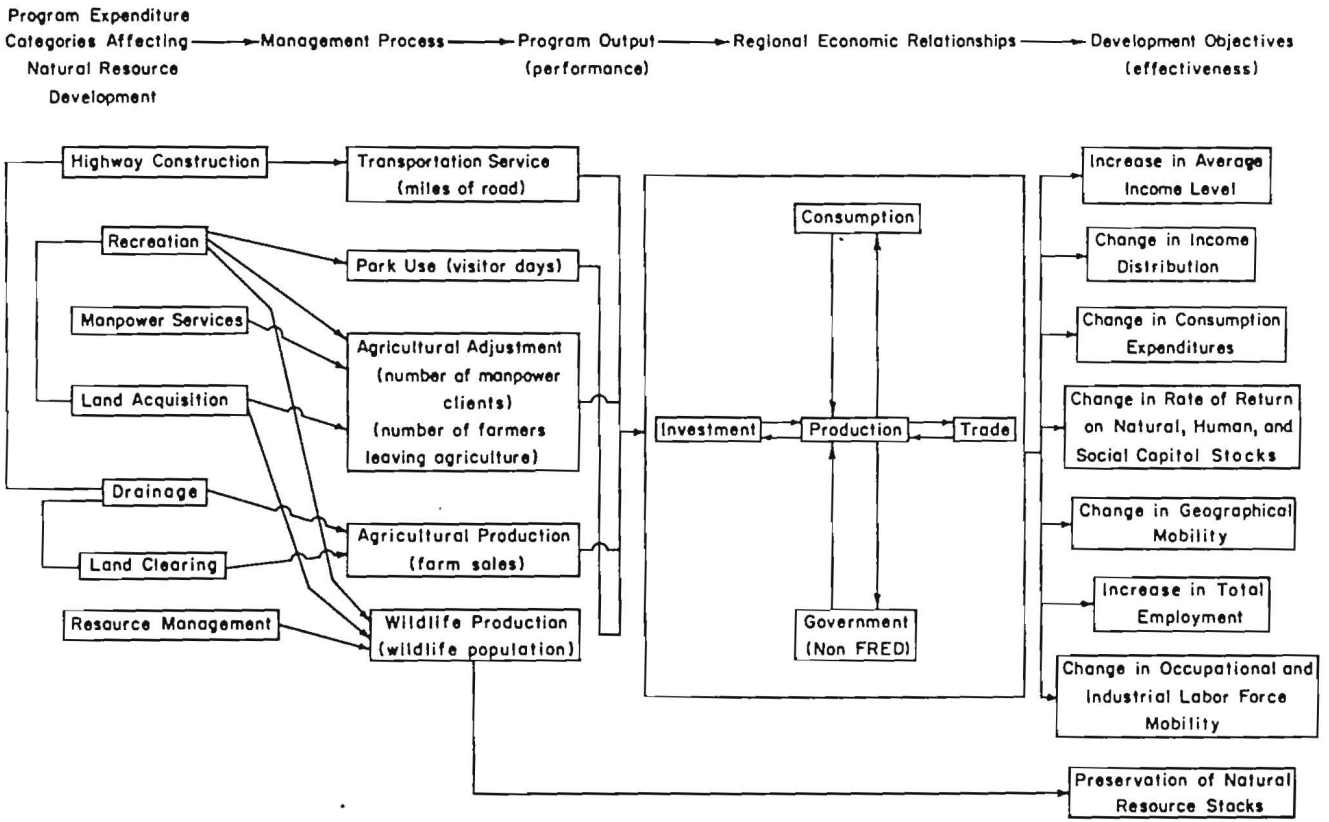
7. Sustainability can productively (perhaps essentially) be approached as a systems issue. The first consideration in applying the systems approach is the description of the system in terms of policy goals and objectives, some of which are in conflict. The usefulness of systems analysis in Manitoba has been demonstrated for rural development problems (Figure 2 and fishery management - Figure 3). A proposed application to agricultural development and sustainability is summarized in Figure 4. A set of program and project alternatives exist with feasibility requirements and constraints relative to achieving positive impacts of relative to policy goals and objectives. Given severe budget constraints choices will have to be made in selecting particular programs to achieve the greatest overall success relative to policy goals and objectives. Public choices are made in a political, economic, cultural and technology milieu.

The system is described and a model designed to accurately represent the process of agricultural development. The model will be based on appropriate received theory, deductive logic, inference and empirical observation. In other words, the systems approach can be viewed as an application of the scientific method and problem-solving--a process of matching problem definition and scientific discovery with empirical evidence. It follows that the overall approach must be interdisciplinary requiring inputs from social and technical scientists, planners and politicians if the full set of interrelationships is to be captured.

A system that is scientifically designed enables researchers or program managers to conduct experiments on the system or on its performance under alternative environmental conditions. This is the role of simulation, or of sensitivity analysis, in the planning and evaluation process. Simulation trials can facilitate diagnosis, forecasting, and evaluating activities by policy makers and plan managers.

Figure 2

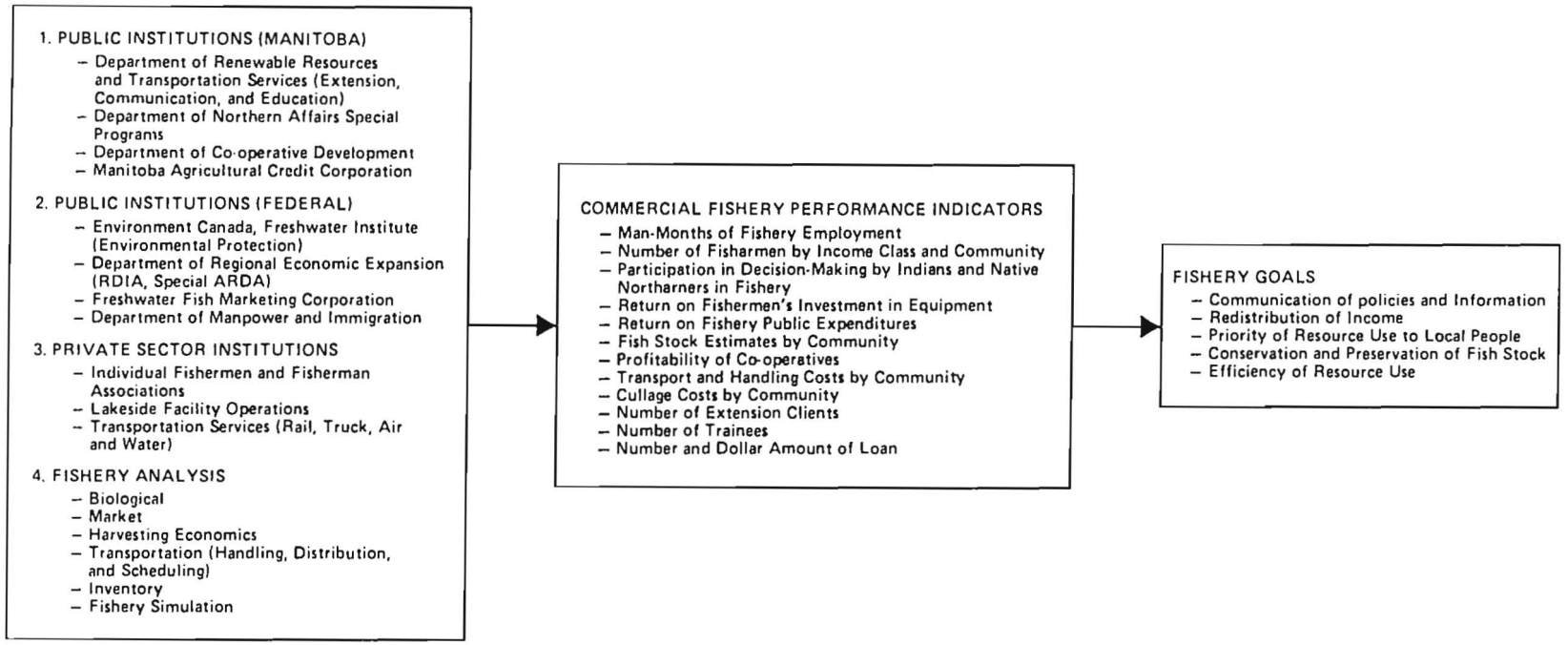
FRED Program Management Interrelationships, Economic Relationships, and Development Objective



Source: James A. MacMillan, Chang-mei Lu and Charles F. Framingham, Manitoba Interlake Area: A Regional Development Evaluation, The Iowa State University Press, 1975), p. 16.

Figure 3

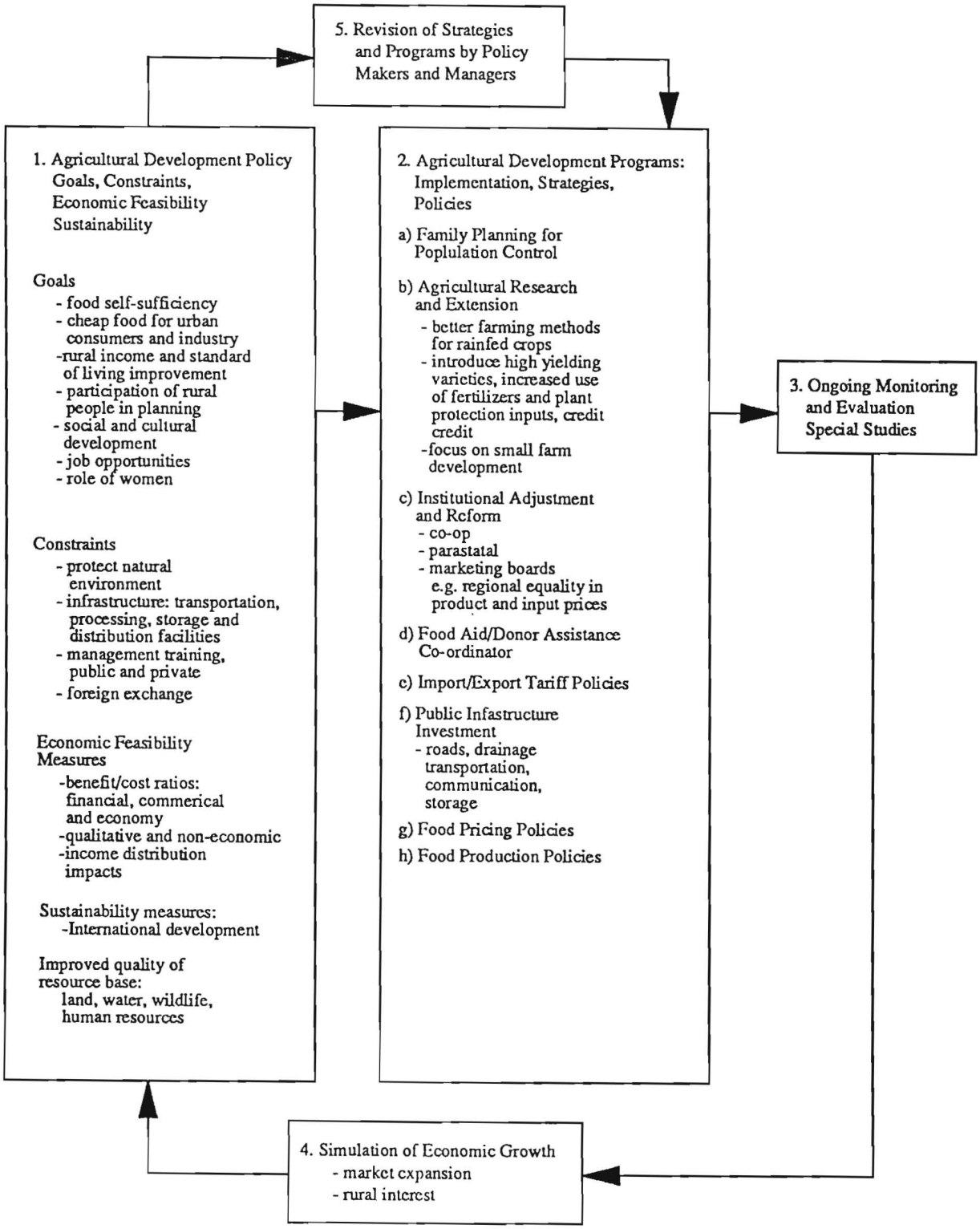
Planning Framework for Freshwater Commercial Fishery Management



Source: Gordon S.Gislason, James A. MacMillan and Jack W. Craven, The Manitoba Commercial Freshwater Fishery: An Economic Analysis, The University of Manitoba Press, 1982. p.6.

Figure 4

Proposed Framework for Systems Analysis of Agricultural Development and Sustainability



Source: Adapted from Yeh, MacMillan, Loyns, "A System Analysis Approach to Rural Development" paper presented to IAAE and CAAS Symposium on Rural Development, Beijing, October 1987

Implications for Intervention by Scientists

If the foregoing discussion of characteristics and requirements for sustainable development has any credibility, there are a number of important implications for scientists, researchers and academics. If we are right on the significance of political considerations, presentation and communication will be an important part of any analysis and research output. If the trade-off/systems hypothesis is valid, we will need to work interdisciplinarily and to provide solutions that have alternatives. If our analysis of developed/developing country differences is correct, different approaches will have to be proposed for countries and programs depending on the state of development. Specifically we suggest the following as initial targets for action:

In developed countries:

1. continue to work to raise the awareness of problems, but in ways that demonstrate prospect for resolution;

2. demonstrate the alternatives, and consequences;

3. demonstrate the political/economic and social consequences of achieving more environmentally friendly economics and production. Sustainable development, sustainable agriculture could be growth industries--energy became a growth sector as a consequence of the energy crisis in 1973.

In developing countries:

1. basic needs (food, clothing, shelter and health for individuals; debt service and foreign exchange liquidity for nations) have to be met; aid contributions must be consistent with those basic objectives and the available resource base. This requires appropriate technology and developing country needs first, not donor industrial interests.

2. appropriate technology requires development of simple, inexpensive sustainability-compatible production techniques and farming systems. Transfer of western technology might work in limited cases; the examples of successes so far are few.

3. allocate government-to-government effort to alter political priorities. Aid resources are scarce; we cannot squander them on unproductive capital or technology in the recipient country or from home. Redistribution of income in most developing countries is essential, but after it has been generated, not before.

Some Examples in Canada and in Developing Countries

Sister Provinces: Manitoba and Saskatchewan

The past two years have produced two large projects by the Provinces of Manitoba (Sale of CFI to Repap) and Saskatchewan (the Rafferty-Alameda Dam). The two projects are related for purposes of this paper, in the sense that Manitoba claims to be at the forefront of sustainable development in Canada, and Manitoba has protested the potentially damaging effects to our environment and ecology of the Rafferty-Alameda Dam.

Both projects have had firm commitment and have been staunchly defended by the respective governments against widespread criticism, often apparently well-informed, from the outside. Both projects have significant economic implications, and both appear to have significant environmental implications. Both projects have long term implications, some of which are likely irreversible. What is not known, and what does not appear to have been generated by either government, is how the economic, environmental, and social issues meld in terms of sustainability. We do not know, and there appears little interest by either government in assessing, the relevance of sustainability to these projects. The political will on these projects is motivated by other considerations and is predominant.

In the context of this paper, what is important about these projects is not that they may not meet the conditions for sustainable development, (the authors do not know the answer to that question, and therefore take no position on it), but that, in the present public environment, the projects would go ahead without demonstrated sustainability, or at least claimed sustainability. As we have said, it is a long trip from political awareness to political action.

Perhaps it could be noted that the apparent lack of progress on the World Centre for Sustainable Development reinforces this same point.

European Community Common Agriculture Policy

During the 1960s, the European Economic Community implemented a significant program of support to grain and dairy producers known as the CAP. Over the years, via high levels of price support, production in the EC grew to the point where, with England in the Community by the mid 1970s, the EC became a major exporter of grains. By 1985, the Community was exporting as much as two traditional exporters combined--Canada and Australia. By 1985/86, this European production was contributing to severe downward pressure on international prices, and disrupting production in traditional exporting countries and in many developing countries. About this time, the U.S. decided to take on the EC to alter their policy and to restore more market oriented conditions in international grain markets. As a result, great grain price war raged for the last half of the 1980's. Prices have been maintained below equilibrium levels and the traditional exporting countries (Canada, U.S., Argentina, Australia) have suffered serious negative effects in terms of their producer incomes and treasury costs. Canada, for example, has pumped an additional one to two billion dollars of support per year to grain producers for about four years, representing total support levels

which reached 50 percent of the value of grain produced in 1987 and 1988. Europe has had numbers at that level off and on for 20 years.

There is little doubt about the seriously negative economic impacts of this process in Europe, in exporting countries, and for many developing countries' production goals. The Community itself recognizes the economic inefficiency created by the CAP and is very aware of the huge fiscal drain it creates.

Production in Europe has also become highly intensive--unusually high prices produce that economic effect. Fertilizer, chemicals, growth stimulants and desiccants, and many pass operations are the norm in European grain production. Land which would otherwise be used for livestock or recreational purposes, or would lie idle, is producing grain. There is little doubt about the negative environmental impacts of the CAP.

All of the above suggest this is not sustainable agriculture as we would like to understand the term, and most analyses would likely support that conclusion. However, switching connotations slightly, CAP has been sustained and shows signs of continuing to be sustained. How can we explain the anomaly? There are several ways but in the end, CAP is sustained by political will.

North Americans are fortunate that they do not understand the importance of meeting basic needs, in particular hunger; Europeans, the Japanese and the Chinese do understand because they have experienced the problems. In addition, in Europe, especially in France and Germany, there is strong social pressure to maintain people on the land, in small units. This all translates into a massive agro-economic grains support system that is economically inefficient, trade distortive, horrendously expensive, and environmentally disruptive. At the same time, this system meets important social objectives, it receives the required political support, and it is sustainable for the foreseeable future.

Wheat Production in Two African Countries: Tanzania and Zambia

When CIDA discovered the need to assist Third World Countries in agricultural development during the early 1970s; one of the models adopted for Africa was Western Canadian dryland wheat production technology. In particular, a major wheat research and production project was developed in Tanzania during the 1970s, and in the middle 1970s an effort was initiated in Zambia to replicate the Tanzanian project.

The Tanzanian project used large-scale mechanized production techniques supposedly patterned after Saskatchewan production. What was to have been a pilot project in the early 1970's developed to a 70,000 acre project in seven approximately 10,000 acre units. It has attempted to serve the demand for wheat flour and bread in the major city, Dar es Salaam, which is about 1,000 km from the farms. Tanzanian roads are poor, the rail system is limited, transportation resources are scarce, and foreign exchange is scarcer.

The Zambian production project was terminated in the early 1980s and converted to a research project which was to investigate varietal, soil, climate, and agronomic requirements of achieving "economic" wheat production in Zambia. The target group of the research in Zambia was originally "commercial" farmers, i.e., those medium to large, mechanized producers which are responsible for a large proportion of total agricultural production. "Commercial" farmer in this context is the opposite of "small holder" farmer who may be only self-sufficient or have a small saleable surplus; and small holder farmers generally operate with hand labour or with limited animal power.

These two Canadian supported projects are interesting contrasts from the standpoint of sustainability. On the environmental side of the issue, we do not have full information but

it appears that environmental considerations should not be an important factor in either case. Both projects are small relative to the available resource base and would not likely create significant environmental damage even if there were any evidence of hazard, we know of no significant environmental hazard at this time.

The economic and social aspects of the programs, as well as the political forces, have been opposites. The Tanzanian project manifests unacceptable economic performance and it is generally accepted that without Canadian support, the project would wind down quickly due to lack of foreign exchange and sheer cost of the wheat. There are several social implications, one of which is very serious. First, the farms are in a sparsely populated hinterland, consequently have been dependent upon skilled labour imported from other areas of the country. The entire 70,000 acre operation employs less than 2,500 people on a full-time basis--therefore, the distributional impacts have been very limited. The farms have displaced many tribesmen--the Barabegs--and their traditional grazing lands with, little recognition of their native rights. Despite these important economic and social negatives, the Governments of Tanzania and Canada remain committed to this project. It is in Phase IV, the farms are being re-equipped with new machines; Canada has injected well over $100 million into the project since its inception in 1969, most of that since 1979. As long as Canadian funds are available, this project is sustainable and it will be sustained.

As already indicated, the large-scale mechanized production phase of Canadian supported Zambian wheat production was terminated in the late 1970s. The results of an evaluation of the research phase which we undertook in 1987 indicated that wheat production as targeted in the research program was not likely to meet economic criteria. However, by improving varieties (yields modestly) and by targeting small holder production, even if for

limited distribution, production had the potential to become economic. Small holder production, if economic, would generate significant social benefits, including achieving improvement in income distribution for whatever income the wheat generated. A study of small holder wheat production in Tanzania undertaken by Frank in 1988, *The Economics of Small-Holder and Large-Scale Mechanised Wheat Production in Northern Tanzania*, reinforces this conclusion for northern Tanzania as well. In other words, there is some evidence that on economic and social grounds, small holder wheat production in both countries might be sustainable. But there is little evidence to demonstrate official acceptance of this possibility among any of the Canadian, Tanzanian or Zambian governments. At this stage, we know of little positive action to confirm or reject the hypothesis.

A Sustainable Project in Kenya
Profitable Integrated Ecological Resource Development

The Baobab Farm Ltd. of Rene Haller illustrates that profitable integrated ecological resource development is feasible. A profitable cement plant hired an agronomist to analyze options for reclaiming the quarries which were a negative impact associated with the production of cement in Mombassa, Kenya. The initial search for trees which would withstand high saline water was successful. Forest production was then integrated with aquaculture and other commercial food products. The process has demonstrated that environmental degradation can be reversed and the resource base quality actually continues to improve over time. Three hundred Africans are employed in the farm and nature trail tourist attraction. Commercial profitability has been achieved without subsidies and without artificial growth or control chemicals. The trees are nitrate fertilizer producers as well as reducing the salinity of the groundwater. Positive contributions have also been made to the goal of food security and several other policy goals.

An Example from Northern Alberta

An integrated wood-fired electricity generation plant combined with a livestock feedlot utilizing aspen pulp cooked with the waste heat can provide a similar profitable integrated ecological resource development in Alberta. A fixed area of aspen can provide a sustained source of aspen for the operation initial estimates indicate that the electricity generated can compete with alternative coal fired electricity the major current source of electrical power in Alberta. In addition the cattle operation also indicated profitability. Environmentally the wood-fired electricity is cleaner than coal and provides a greater impact in terms of jobs and income generated. From the point of view of integrated ecological operations a substantial number of additional profitable activities are being examined.

Conclusions

Various definitions of sustainability are reviewed in the context of five socio-political pressures. Public choice issues are reviewed in a five step systems analysis framework for agricultural development and sustainability involving: 1) goals, 2) programs, 3) evaluation, 4) simulation and 5) revision of programs based on feedback. The system provides a framework for considering sustainability impacts of: 1) European agricultural pricing policies, 2) developing country small versus large farm wheat production technology, 3) cement quarry reclamation in Kenya, and 4) complementary livestock feeding and wood-fired electricity generation in Alberta.

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Federal environment plan bogs down

BY ROSS HOWARD
The Globe and Mail

OTTAWA

Environment Minister Lucien Bouchard's ambitious plan to make the environment a top federal priority and a key concern for citizens and industry is bogged down inside the government itself.

The plan is far behind schedule, and it failed to receive Finance Minister Michael Wilson's support for a five-year, $2-billion direct commitment to environmental protection, scientific research, public education and tax breaks for firms that best reduce their pollution.

Mr. Bouchard got the cabinet's green light last August to develop the plan and present it publicly this month with the federal budget because it included financial measures.

But he confirmed this week that the plan will not be released with the budget. Releasing it in March at a world conference on environment technology in Vancouver also has been scrapped.

"I would personally like it to be made public in the spring," Mr. Bouchard said in an interview. But "I don't know exactly when I will be in a position to make it public" because the plan is far short of cabinet approval.

Mr. Bouchard was positioned by Prime Minister Brian Mulroney, a personal friend, as the government's white knight on the environment front, a consistently weak area in opinion surveys on the government's performance.

"Funding must be increased, and it is part of the job of the environment minister to fight for it even if we have very tough circumstances within the government," Mr. Bouchard told the House of Commons Environment Committee on Oct. 5.

The slow progress and large price tag make it unlikely the plan will emerge until fall, in an indeterminate form, departmental sources said. The lack of financing has obliged the bureaucrats to restore an emphasis on new anti-pollution laws

ENVIRONMENT — Page A3

Lucien Bouchard

Kenyan 'Garden of Eden' proves that ecology pays

By Julian Ozanne

Financial Times of London

MOMBASSA — René Haller is extremely modest for a man who has been compared to Moses and Darwin, after turning 250 acres of exhausted quarry into a paradise on the Kenyan coast.

After the Ethiopian famine, the agronomist and entrepreneur received a blizzard of publicity. His reclamation project became a victim of media exposure. The man became more important than the message.

"People were fed up with reading about disaster," Haller says. "They were desperate to say something positive about Africa and they were looking for a figure to promote.

"But there is no way this whole project came out of my head alone. Ideas came from farmers, tribesmen, students and professors. I was just the catalyst and the man who made things work."

What Haller has done is turn a devastated desertland into a fertile tropical arcadia, making it difficult to avoid the Biblical imagery of creating a Garden of Eden from the lifeless origins of the planet.

The project began 15 years ago when Bamburi Portland Cement Co., Kenya's largest cement producer, discovered its environmental conscience.

It decided something had to be done with the gaping scars left in the landscape by fleets of bulldozers excavating coral rock for limestone used in cement. The machines uncovered layers of the earth that had lain undisturbed for half a million years. In their wake, a wasteland was taking shape, nearly lunar in its bleakness.

Wounded land

Haller was the perfect choice to restore the wounded land. He had spent several years studying indigenous agricultural practices around East Africa.

His successful attempts growing vegetables at the coast had already taught him to be skeptical of conventional Western wisdom, and in the absence of any authoritative literature on reclamation in Africa, he was willing to experiment.

First he tried 26 different trees to find one that would thrive in the salty soil and warm, humid weather. The best proved to be a common tree growing in his own back garden, the casuarina, a scanty Australian pine tree that produces its own nitrogen.

Haller also found that, contrary to what he had been taught at university, the seedlings developed better in sand than in compost because micro-organisms introduced thrived better.

When the fledgling casuarina began to drop their needles, he introduced thousands of millipedes and earthworms to create a carpet of thick, rich humus.

As the forest took off, Haller began to dig fish ponds. After several trials, he stocked them with tilapia, a tropical fish capable of tolerating high salinity. Next he introduced several African antelopes, elands, water buck and oryx, to form a brigade of natural lawn-mowers and fertilizers.

Today, the casuarinas planted 15 years ago have developed into a thick, shady forest where other trees and vegetation have found a home.

With the completion of a nature trail the image of Eden seems complete, with tourists wandering through a verdant forest that might have been created for them. There are herds of antelopes grazing in forest clearings, hippos wallowing in clear blue pools, buffaloes, birds, peacocks, giant tortoises and crocodiles.

But beneath the glamorous facade of a paradise regained is a complex, balanced and commercially viable aquaculture farm. Within the system, every animal has a specific role — even man, with visitors' fees proving a valuable source of supplementary income.

At the system's centre is a fish farm that produces 440 pounds of fish a day. Sally, a 1.5-metric-ton hippopotamus, is the linchpin of the farm. Haller found that hippo excrement stimulates the growth of algae, which in turn oxygenates the water, thus improving breeding conditions for the tilapia. The hippo moves around a lot, stirring the mud on the bottom of the pools and preventing the buildup of toxic gases such as hydrogen sulphate.

Nothing is wasted. The water from the fish tanks is flushed out, rich in fecal matter and nutrients which are used to make fertilizer and biogas to run pumps. The water then flows into the crocodile farm.

Crocodiles, used as natural garbage cans and valuable for their hides, also stimulate the growth of algae. From their pool an algae soup is flushed into the water system during maximum sunshine, when photosynthesis releases oxygen into the water.

The water then flows through floating rice and Nile cabbage fields where the nutrients are sucked out and put to productive use. Then the clean water is pumped back into the fish tanks.

The farm also produces bananas, tomatoes and spinach. The casuarina trees are harvested as a cash crop for sale as building poles and charcoal.

No chemicals

Haller rejects the use of chemicals and fertilizers, believing nothing should be brought into the balanced ecosystem that is not compatible with the existing environment. Beetles are controlled by owls. Rats are kept in check by snakes and peacocks, which in turn are prey for monitor lizards.

The project, initially dependent on financial support of the cement company, now turns over a healthy profit and employs 260 people. Haller has proved ecology can pay.

His intensive aquaculture and agroforestry techniques, geared to maximum yield of food, fuel and income from minimum acreage and inputs, offer significant hope for small-scale African farmers. Haller also believes the commercial production of fish will become a vital source of cheap animal protein.

His methods can easily be adapted by Africans, he says, since their genesis lies in the traditional tribal techniques taught him by local farmers. And he is anxious to divest the mantle of miracle-maker forced on him by the media.

"There's nothing magical about what we have done here. Sometimes we've just accelerated the natural process," he says.

The natural order Haller has created stands as a delicate jigsaw puzzle. But the ecosystem now seems capable of regenerating itself, and as much as five acres a year are being reclaimed naturally without human intervention.

Whenever the bulldozers move out at Bamburi, leaving blighted land to be reclaimed, Haller eagerly moves in behind them with a vision that is limitless.

"I have got so much that I still want to try out. I keep thinking there has to be a better way," he says.