Sustainable Development: Challenges to the Profession of Agricultural Economics*

by

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> "Fundamentally, 'sustainable development' is a notion of discipline ....disciplining our current consumption. This sense of 'intergenerational responsibility' is a new political principle, a virtue that must now guide economic growth. The industrial world has already used so much of the planets' ecological capital that the sustainability of future life is in doubt. That can't continue." (Brundtland, p. 5)

As the epigram implies, in this article I examine the concept of sustainable development and discuss how this concept can be expected to impact on agricultural economics as a discipline and agricultural economists as professionals.

Sustainable development as a concept represents the latest step in a long evolution of public concerns with respect both to natural resources and to the environment. World War II provides an approximate dividing line between "old" and "new" values associated with natural resource and environmental concerns (Hays, 1987). Prior to World War II, these concerns were those of the Progressive Conservation Movement whose advocates emphasized technically efficient development of such resources for use as material commodities. After World War II, the emphasis increasingly shifted to the aesthetic and amenity uses of natural resources. This new concern was manifested in a rapid growth of interest in outdoor recreation in the 1950s which then extended into protection of natural environments. More recently, the role of natural resources in maintaining a healthy and stable ecological setting for all life has received emphasis.

Recently, environmental tragedies, such as the Bhophal accident, the contamination of Love Canal, the poisoning of the Rhine River, the Chernobyl nuclear explosion, and the desertification of agricultural lands, have sensitized the public everywhere to environmental quality issues. At the same time, the prospect an end to Cold War concerns has made room for environmental issues on the policy agenda of political leaders throughout the world.

> In the industrial north, leaders as divergent as Margaret Thatcher and Mikhail Gorbachev are coming to the conclusion that their societies face real costs in terms of pollution and environmental degradation. These leaders have not simply latched onto a temporary swing of the pendulum. They are articulating a... change in our perspective of the human condition and our relationship as a species to the ecosystems which have sustained our evolution. (Piddington, p. 8)

Included in this perception is the conviction that economic development must consider both protection of natural resources and maintenance of environmental quality. The result is an emerging concept, one that is increasingly guiding environmental policy and, to a lesser extent, agricultural, economic, and development policy. The descriptive term for this perception is "sustainable development." Sustainable development concepts are used to defend programs to encourage low-input agricultural systems for managing pollution, policies to reduce global warming, and provisions for the protection of tropical rain-forests.

The concept of sustainable development began in the United Nations in the mid-1960s (O'Riordan), and it has since gained prominence as a central feature of United Nations' development and environmental philosophy (World Commission on Environment and Development, 1987). Sustainability concepts are now increasingly incorporated into programs of The World Bank (Davis and Schirmer) as well as environmental organizations such as the World Resources Institute, the World Wildlife Fund, and the Conservation Foundation (see for example, Repetto, 1987). The concept is prevalent in European politics and is frequently associated with the Green Party (Capra and Spretnak). Today, the reasoning that created the ecological "Green" politics of Europe is gaining strength in the United States. Sustainable development concepts are also being integrated into various academic programs--more so in biology, ecology, and planning than in agricultural economics.

A substantial intellectual history that includes contributions from ecological sciences, ethics, and economics undergirds the concept of sustainable development. In its more extreme versions, this concept challenges a basic belief of modern industrial society (Francis), that is, that economic growth is desirable. The concept also challenges the assumptions of the conventional neoclassical economics approach to policy analysis. As a result, tension

exists between sustainable development concepts and those of agricultural economics, at least as the profession is usually practiced.

Sustainable development--even in its less extreme versions--resurrects the classical concept of absolute scarcity. Most sustainable development advocates believe that the possibilities for economic growth are limited both by natural resource quality and by the assimilative capacity of the environment. In addition, the advocates question conventional economic assumptions relating to the possibility of prediction, the nature of externalities, the source of values, the validity of discounting, and the concept of equilibrium.

However, the concept of sustainable development is amorphous--it is perceived differently by different people. The sustainable development theme seems to encompass everything from global warming to aboriginal cultures. This lack of precision often obstructs the drawing of implications. Nevertheless, the implications that sustainable development themes have for our discipline are important, especially so, since sustainable development concepts are becoming so widely debated and are gaining disciples both in the United States and abroad. At a minimum, one can argue that agricultural economists should develop as thorough an understanding of the concept as possible. Beyond mere understanding, there are payoffs to more comprehensive analyses of sustainable development concepts. These analyses can include critiquing sustainable development proposals, designing institutions which incorporate sustainability goals, and addressing fundamental questions raised by sustainable development advocates. These questions involve the determinants of and interrelations between growth, distribution, resources, environmental quality, and human welfare.

Such an exploration and extension is a challenge to our profession. Because sustainable development concepts are gaining in legitimacy, agricultural economists interested in agricultural policy, economic development policy, and natural resource policy may ignore these challenges at the peril of increasing irrelevancy.

In this article, I will delineate the concept of sustainable development, review its intellectual history, discuss its relationship to neoclassical economics, and conclude with an analysis of the implications that it has for our profession.

Sustainable Development: What is it?

There is consensus among its advocates that sustainable development is a concept based on intergenerational equity--that is, the current generation must not compromise the ability of future generations to meet both their "material needs" and to enjoy a healthy environment. Within this general consensual framework, there are different interpretations. Two different general definitions encompass most interpretations; these are the constrained economic growth definition and the maintenance-of-the-resource definition.

Some advocates define sustainable development as the pursuit of economic growth [as measured by the Gross National Product) subject to environmental constraints. The "maximize-subject-to-constraints" criteria can be described as having two stages: first, the establishment of some contractional arrangement, incorporating ecological principles and environmental ethics to establish the "rules" applicable to the development policy. Second, within those rules, the utilitarian stance of economic maximization can be adopted (Pearce, 1987a). This two-stage perspective, which many economists and some environmentalists hold, leads to advocacy for discovering the "right" incentives to produce solution-oriented technologies and the "right prices" to internalize the externalities (Speth).

Variations of this constrained growth perception of sustainable development are held by those who see sustainability as economic growth that can be sustained through time as measured by maintaining productivity at relatively constant prices. Alternatively, the constrained growth perception can mean either maintaining productivity per capita or maintaining real wages per capita throughout time (Cleave). Turner refers to this view of sustainable development as a conservationist position. The maximize-subject-to-constraints variation of sustainable development differs little from the traditional approaches of many development and natural resource economists.

However, this view is not acceptable to all advocates of sustainable development. Advocates of a "maintenance-of-resource" type of society disdain the two-stage maximization perspective; they argue that "well-being is not the same as well-having," and that nature is to be respected and not "exploited" for production inputs and outputs (Sachs). They use the concept of sustainable development to imply "enoughness"--that is, greatly reduced rates of economic growth--at least for developed nations.

> The interpretation of the state of the world in terms of "resources", "management", and "efficiency" may appeal to planners and economists, but it continues to promote development as a cultural mission, thereby further shaping the world in the image of the west. (Sachs, p. 19)

Sustainable development as "resource maintenance" is a minimization concept that implies minimizing the use of the natural environment; this concept of development meets the "material needs" of people while protecting the environment (Tolba).

O'Riordan and Turner distinguish two themes in this resource maintenance view of sustainable development: one is a preservation ecocentric position that emphasizes the need for severe constraints on economic growth within a decentralized socio-economic system. The other is an extreme preservationist view, or "deep ecology"ecocentrism, that is dominated by concern with rights for non-human species. In agriculture, deep ecology views are frequently held by the more radical "animal rightists."

These diverse definitions about sustainable development pose a risk for any generalization. However, sustainable development has the characteristics of an alternative belief system, a system that can be described through several general characteristics. Advocates of sustainable development:

- perceive that the biosphere imposes limits on economic growth,
- express a lack of faith in either science or technology as leading to human betterment,
- are extremely averse to environmental risks,
- support redistributive justice and egalitarian ethics,
- profess concern over population growth and have faith in the wisdom of human capital development, and
- have survival of species and protection of the environment and of minority cultures, rather than economic growth per se, as goals.

Not all advocates necessarily embrace all these beliefs, of course. Furthermore, these views are more accurately attributed to the "maintenance" school of sustainable development thought than to the "constrained growth" school. However, for the purposes of exposition, I

will describe this belief structure as that held by a "representative" sustainable development advocate.

Limits Imposed by Biosphere

Sustainable development is a concept that implies limits, both to the assimilative capacity of the environment and to the capability of technology to enhance human welfare (World Commission on Environment and Development). To sustainable development advocates, the capacity of the environment to assimilate pollution from peoples' activities is the ultimate limit to economic growth. Of related and equal concern is the extinction of biological resources; sustainable development advocates emphasize the irreversibility of such change and the diminuation and instability of the quality of life that accompanies an increasingly less diverse and simplified ecosystem.

> The immediate need is to preserve the normal function of biotic systems that are the basic components of the biosphere. Preservation of the physical, chemical, and biotic integrity of those systems is paramount. Obviously, there must be room for man....But man's activities, if they are to be sustainable, must not exceed close and finite limits and impair the normal function of ecosystems.... (Woodwell, p. 62)

A recent example of this concern is that of the global warming that results from man's activities, an outcome that has the potential to irreversibly change the earth's climate and to inflict damages on biological and human systems.

Lack of Faith in Scientific and Technological Progress

Many sustainable development advocates do not have faith that either science or technology leads to human betterment. Science and technology are seen more as problem-creating than problem-solving (Douglas and Wildavsky). Thus, to many sustainable development advocates, "technologically possible" does not equate with "ethically desirable." Technology is not seen merely as a way of harnessing nature to serve the needs of an industrial society. "It is also frequently the instrument through which alienation is effected in rural areas... (of developing nations): people are separated from their land, women

from their control over household resources; cultural practices that evolved to sustain both production and the environment are lost" (Redclift, 1988, p. 64).

An example of the purported harmful effects of technology and science-based products that is often referred to by sustainable development advocates is that of the Green Revolution (Redclift, 1987). This revolution introduced "miracle" seeds, agrichemicals, and machinery into developing nations' agricultural systems. Sustainable development accusations against the Green Revolution are several-fold: (1) the new plants lack pest immunities of the traditional plants; therefore, they require extensive use of chemicals; (2) the required chemicals increase farmer debt and injure human health; (3) the excessive use of required fertilizers contaminated ground and surface water; (4) the soil has become impoverished; (5) the farmer has been dehumanized by his increasing reliance on experts; and (6) the resulting economic growth has been inequitable.

Sustainable development advocates argue that there must be "appropriate technology" applied to development problems. Appropriate technology is not harmful to the environment--"it fits within the biophysical and socioeconomic parameters of the environment on which it is imposed" (French and Schmidt)--and is respectful of and does not dominate the needs of the local population, their culture, and their natural environment. In the United States, low input agricultural systems (LISA) are frequently suggested as appropriate technology to meet environmental concerns (Lockeretz).

Aversion to Environmental Risks

The belief in environmental limits espoused by sustainable development advocates, coupled with their lack of faith in science and technology, translates into extreme aversion to environmental risks. Like much of society, sustainable development advocates tend to choose strategies that minimize possible maximum-regrets (Kahneman and Tversky). They also treat involuntary risks very differently than voluntary risks (Douglas and Wildavsky). Sustainable development advocates are willing to accept very high opportunity costs to avoid future environmental risks. They demand that the burden of proof be placed on those seeking to use the environment to show that they are not harming nature or people, and they want to minimize the possibility that an action will be deemed benign or sustainable when it might, in fact, be

harmful or non-sustainable. In the United States, such attitudes are reflected by the public's response to use of alar (daminozide) on apples or to detection of extremely low residues of agricultural chemicals in drinking water (Batie).

Redistributive Justice and Egalitarian Ethics

The objectives of a sustainable society reflect the "Maximin" strategy: namely, maximize the well-being of the most disadvantaged individual in society (Schulze and Kneese; Pearce, 1987a). These objectives are based in egalitarian ethics: all persons should be accorded equal opportunity of access to natural resources and quality environment (Shrader-Frechette). However, the important question of "What is the minimum set of resources that should be available to all generations?" is not precisely addressed by sustainable development advocates. The question is particularly difficult given the capability of technology to expand the carrying capacity of the environment (DeGregori).

Redistributive policies between members of the current generation and equality of access to resources for all generations require a marriage of environmental protection to economic development goals. Sustainable development advocates argue that development is not measured by standards such as [conventionally measured] increases in Gross National Product; rather, emphasis is placed on improving income distribution and health, as well as education and employment levels (Tolba). Development objectives are selected and driven by their environmental and distributive consequences. Emphasis is placed on self-sufficiency, achieved through the use of both local and renewable resources wherever possible.

Limiting Population Growth and Investment in Human Capital

Sustainable development is not viewed as a concept applicable only to developed nations; rather it is "increasingly seen as a necessity for developing nations seeking to industrialize and expand their economies. That is, these essentially resource-based economies require...sustainable management of their resource base in order to ensure the success of their long-run development efforts" (Barbier, p. 37).

As a result, population growth is an important central concern to sustainable development advocates. The four-fold increase of population in the twentieth century is seen as an

immense ecological force without precedent in world history (Raven). While it is recognized that the rapid population increase has also been accompanied by a seven-fold rise in real per capita income worldwide (Brown as quoted by Krahl and Cook), there is concern over the great disparity in the distribution of human welfare gains. Sustainable development advocates frequently note that about 30 percent of the world's population currently consume more than 70 percent of the global resources (Barbier).

Poverty is viewed as an important cause of natural resource degradation, and sustainable development is seen as a vehicle for alleviating both poverty and natural resource degradation. Indeed, development is viewed as being unsustainable unless the needs of the poor are met (Redclift, 1987). The sustainable development policy emphasis is on redistributing assets and property rights, redirecting government programs toward the disadvantaged [particularly minority cultures] and low-income countries, improving the position of women in the culture, and improving human capital by expanding educational and employment opportunities (Repetto, 1985). However, while reducing population increases is seen as important, the relationships between alternative world population levels and sustainability [that is, the "carrying capacity" of resources associated with alternative population levels and various technologies] have not been well examined by sustainable development proponents.

Goals

Sustainable development advocates have protection of both the environment and the minority cultures as goals; economic growth[1] is seen either as constrained by these goals or as being antithetical to these goals. One sustainable development advocate summarizes the sustainable development concept by noting that every development policy must be scrutinized to determine whether it:

- is fundamentally supportive to the natural environment;
- evaluates the demands on limited global resources;
- considers alternative resources which are local and renewable;
- encourages an improved standard of living for those existing in degrading conditions;
- encourages self-sufficiency;
- requires the protection of life from toxic and carcinogenic substances, and

- respects the dignity and intrinsic worth of all life. (Martin-Brown, page 13-14)

For example, consider deforestation of the Amazon as a contributor to the global warming phenomena. Sustainable development advocates are likely to argue that a policy response should involve either adaptive measures or preventive measures. Preventive measures include the development of a global food security system, the provision of financial assistance to developing nations, and the allocation of developmental funds to sustainable agricultural development (Barbier). Adaptive measures include reducing fossil fuel burning, particularly through the development of non-fossil fuel energy sources, halting tropical deforestation, replanting in deforested areas, and assisting aboriginal cultures (Barbier).

The basic concept of sustainable development is clearly underlain by an ethical norm (Burkhardt). This norm captures changing public ideologies about the relationship of humans to their environment, from that of "conquest and exploitation" to that of "cooperation and coexistence" (Nash). The norm also encapsulates a new culture of distributional justice. In so doing, it casts new meaning as to the appropriate elements of economic growth, and it challenges the status quo (O'Riordan).

Intellectual History: From the Gospel of Efficiency to the Gospel of Ecology

The sustainable development concept finds its intellectual heritage in the Progressive Conservation Movement of the 1890s to 1920s. This heritage is important because the same progressive theme that influenced the movement is reflected in the orientation, methods, and rhetoric of agricultural economists.

While there are many similarities between the Progressive Conservationists and sustainable development advocates, there are many differences as well. These differences include differing concepts of sustainability, differing conceptions as to limits to growth, and differing ideologies as to sources of value. The differences in values are important in helping us understand the implications of sustainable development.

The Sustainability Concept

The concept of sustainability was embodied in the Progressive Conservationist ideology--although the meaning of the term was not that of today's sustainable development advocates. To Progressive Conservationists, sustainability meant alleviating waste through proper pricing and regulation (O'Riordan). Their goal was technical efficiency with respect to all resources; however, when given an option, they preferred that renewable rather than non-renewable resources be used. For example, the Progressive Conservationists promoted a theme of "scientific forestry" that included not only reforestation, but also sustained-yield forestry management to produce a continuous flow of timber resources (Hays, 1987).

The Progressive Conservationists held an ethic that was not synonymous with the ethics held by the sustainable development advocate. Indeed, Gifford Pinchot, founder of the U. S. Forest Service and intellectual leader of the Progressive ideology, repeatedly asserted that conservation did not equate with protection of nature (Nash, 1989). Instead, conservation meant technically efficient resource development--so much so that the Progressive Conservation Movement ideology has been termed "The Gospel of Efficiency" (Hays, 1959).

Sustainable development concepts also include alleviation of waste--but alleviation according to the "Gospel of Ecology"--not the "Gospel of Efficiency" (Nash, p. 9). This alternative philosophy embraces concepts of ecology and rejects the concept that humans are exempted from ecological constraints (Francis).

A recent example of policies incorporating sustainable development concepts can clarify the distinctions between sustainable development and Progressive Conservation concepts. The Washington Post reporter, William Booth (1989), reported that a team of biologists and economists have found that the "forests of the Amazon are worth far more money if harvested for fruits and rubber in a sustainable way, than if cut for timber or cleared for cattle ranching" (p. A-1). Furthermore, the scientists rejected the creation of parks as a protection for forests: "unless the forests are of economic value to their stewards, scientists say the habitat will ultimately be destroyed" (p. A-22). This recommendation to protect forest diversity by allowing and encouraging minority cultures to use the forests in traditional ways is one example of a sustainable development program. In contrast, the Progressive Conservationists

would have proposed parks to protect the forest resource in order to practice expert-managed optimal forest rotations and to take sustained yield harvests.

Limits to Growth

The Progressive Conservation proponents believed in the existence of limits to growth--limits imposed by physical assets such as land productivity. Therein lay the rationale for wise and [technically] efficient use of natural resources. However, the Progressive Conservationist's philosophy embodied a strong faith in science as the path to human welfare (Batie, Shabman, and Kramer). Science could help, if not to overcome the physical limits to growth, at least to push these limits back through scientific management and technological progress. Their faith in science was coupled with the conviction that resource conservation was best left to specialized technical experts, that is, "managers" (Nelson). These managers were to be in service of, but separate from, politics (Shabman, 1989).

> Under broad framework guidance from political bodies, the solutions to modern society would be found in careful, unbiased evaluation of technical, economic, and social facts. This model of a separation of politics from administration held a significant place in the professional literature. By the 1930's, these views were incorporated into the structure of agencies of government. From the TVA to the SCS to the vast array of regulatory agencies, trust in the technical expert was seen as the best way to develop public programs. (Shabman, 1989, p. 3)

Sustainable development advocates depart notably from Progressive Conservationists in their limited faith in the evolution of science and technology as the route to improved human welfare:

> The experience of the 20th century has shattered this transcendental attitude of evolutionary progress: Auschwitz and the Gulag, ozone depletion and the "greenhouse effect" have all destroyed faith in the inevitability of a better future. (Touraine, p. 34)

Of exceptional importance to agricultural economists is this fact: sustainable development advocates tend to reject scientific management of natural systems. "[Sustainable de-

velopment] urges societal adaptation as the appropriate response to new ecological awareness, rather than more sophisticated, expert dominated management" (Francis, p. 66). The guiding concepts are ecological: "technological-scientific power must be checked by ecological rights" (Touraine, p 34). Sustainable development's limits to growth are not those of resource productivity; rather, they are those that are imposed by the environment and its capacity to assimilate the waste residuals of human activities. Nature is seen as something humans are a part of, not something to which they are superior, or of which they are the managers.

Ideology of the Source of Values

Many advocates of sustainable development reject the utilitarianism and anthropocentrism that characterized the ideology of early Progressive Conservationists (Shrader-Frechette; Nash). Utilitarian ethics holds that the value of animals and plants and their "right to life" depends on their value to humans. Pinchot, for example, unequivocally declared the utilitarian objective of federal conservation programs:

> The object of our forest policy is not to preserve the forests because they are beautiful...or because they are refuges for wild creatures of the wilderness...but...(for) the making of prosperous homes.... Every other consideration is secondary (Pinchot as quoted by Hays, 1959, p. 42).

That is, using a utilitarian criterion, the role of government is to maximize the utility of society as a whole (Schulze and Kneese). Or, as the Progressive Conservationists poetically believed [despite its mathematical impossibility]: "the greatest good for the greatest number over the longest period of time."

In contrast, sustainable development advocates eschew utilitarian ethics and promote egalitarianism as a guide to policy; they are more likely to follow the lead of Leopold, where humans are seen as merely "fellow voyagers with other creatures in the odyssey of evolution." (Leopold as quoted by Nash, p.77)

Neoclassical Economics and Sustainable Development Concepts

Much of the orientation of the agricultural economics and economics professions reflects the same progressive influences that motivated the Progressive Conservationists (Nelson; Shabman, 1989). For example, the Progressive Conservation movement advanced the concept of professionalism and the attendant requirement of the need to be "scientific" and nonpartisan--a requirement for what Nelson terms "the Progressive Neutral Expert" (Nelson, p. 53). Nelson notes that many economists still envision their policy-making contributions in the progressive tradition:

> The proper role for an economist is typically regarded as a professional expert who advises government in technical and scientific matters and takes social values and political preferences as given. Once these values and preferences have been expressed by political leaders, economic expertise can be applied to make the governing process work as efficiently and effectively as possible. For example, the standard procedure of specifying an objective function [based on social values and democratic preferences] and then finding the maximum solution [the technically efficient answer] is a direct translation from progressive themes. (Nelson, p. 54)

At the same time that Progressive Conservationists were influencing development and conservation policy, economists were expanding the implications of the "Hicksian" or ordinalist revolution of the 1930s (Cooter and Rappoport). Members of the earlier school of economics, the marginalist school of the late 1800s, were concerned with material welfare, income redistribution, and alleviating poverty. This orientation contrasts sharply with the new framework provided by the ordinalists. Using positivist methodology, ordinal utility, and the scarcity definition, the ordinalists' agenda centered on the production and exchange of commodities (Cooter and Rappoport). Thus, we find that much of conventional natural resource economics now focuses on the optimal rate of exploitation for a natural resource whose primary value is as a productive input into the economic process (Barbier). Even environmental economics, which tends to address the environmental services of natural resources, has paid little attention to the trade-offs between economic activity and natural resource quality

(Barbier). Pollution is treated as a separate problem of market failure and is not incorporated into the analysis of natural resource scarcity (Barbier).

Neoclassical, ordinalist utilitarianism also rejected the classical, marginalist notion that utility was observable and, therefore, that it was possible to maximize the sum of utilities across people. The implications of this notion are explored by Page (1982):

> If interpersonal comparisons of utility are impossible, then we are no longer able to maximize the sum of utilities across people. So the neoclassical utilitarian defends a weaker kind of maximization process in which each one maximizes his own utility. The classical utilitarian's moral principle, which says to maximize the sum of utilities, is strong in the sense that it sometimes directs people to act against their own selfish interests. The corresponding, weaker neoclassical utilitarian's moral principle says that we should move toward Pareto optimality. This principle is weaker in not requiring individuals to act against their own selfish interests. It is also weaker because in many situations it does not tell us what to do [it is a partial ordering]. (p. 45)

Pareto optimality can block consideration of those redistributive policies that make anyone worse off unless gainers can compensate the losers--no matter what the intent of the policy (Kneese). As a result of the ordinalists' perception of utility, distributional policy issues were not a major component of their research agenda.

The majority of the concepts, tools, rhetoric, and research interests that agricultural economists and economists brought to the evolving post-World War II environmental concerns are rooted in Progressive Conservation and ordinalist traditions. Thus, the economics profession has sought since the 1930s to create a "scientific" profession focused on the more tractable [i.e., measurable] economic efficiency issues rather than on the growth and distribution issues (Shabman, 1989). Furthermore, economic contributions also reflected the marginalist school of economics in that they were, for the most part, mechanistic, deterministic, static, and based in utilitarian ethics (Norgaard, 1985).

The sustainable development ideology challenges many of these concepts and traditional economic methods. Consider the neoclassical economic topics: limits to economic growth, benefit-cost analysis, economic value concepts, externalities, and equilibrium concepts.

Limits to Growth

"Neoclassical economics, like classical physics, is a special case that assumes that we are far from limits..." (Daly, 1987, p. 324). For example, the economic circular flow analogy links natural resources with production and consumption goods and is rarely portrayed as influencing or being influenced by the natural environment--thus there are no constraints on economic growth. Resources in the neoclassical models are either neglected or assumed to be generated by labor and capital--a sort of perpetual motion machine (Kneese). "Economic science appears to say nothing about any existential relationship between the organization of an economy and the set of ecosystems to which it relates." (Pearce, 1987b, p. 6)

Furthermore, the profession has long been investigating the interests of the Progressive Conservationists--that is, are there limits to growth posed by the physical exhaustion of natural resources?[2] Since the book by Harold Barnett and Chandler Morse *The Scarcity and Growth: The Economics of Natural Resource Availability*, was published over 25 years ago, economic literature has addressed the limits-of-growth issue or the related ones of optimal depletion rates. Teachers, myself included, have delighted in using this literature[3] to challenge the "myths" held by the freshman student as to the scarcity of resources. We teach that the Malthusian trap may be eluded by technological advance, and that the quantity of resources are not limiting: the only limits to growth are those of the human mind (Simon, DeGregori).

The wisdom of such conclusions aside, these physical limits are not the ultimate limits to growth that occupy the minds of sustainable development advocates. Rather, these advocates are concerned with limits to growth posed by the pollution of the environment. In this context, even if a particular scarcity index trends downward, the trend matters little if it comes at the expense of environmental quality. Thus the sustainable development concepts directly challenge the neoclassical and Progressive Conservationists' faith in expert management of technology to offset resource depletion.

Moreover, the nearer we are to ecosystem limits, the less valid is the assumption that economic welfare and total human welfare move in the same direction (Daly, 1987). The existence of these limits calls into question both the desirability of economic growth and the sustainability of economic growth. The "affluent" society is equated with the "effluent" society

(Spengler as quoted by Daly, 1968, p. 396); appropriate development strategies are those of maintenance of resource stocks and the minimization of resource flows, but not "efficient" growth. Thus:,

> The essential measure of the success of the economy is not production and consumption at all, but the nature, extent, quality, and complexity of the total capital stock, including in this the state of the human bodies and minds included in the system.... [A]ny technological change which results in the maintenance of a given total stock with a lessened throughput [that is less production and consumption] is clearly a gain. This idea that both consumption and production are bad things rather than good things is very strange to economists, who have been obsessed with the income flow concepts to the exclusion almost of capital-stock concepts. (Boulding, 1966, p. 9-10)

Benefit-Cost Analysis[4]

Benefit-cost analysis embodies a particular way of viewing the world, and it reflects particular ethical premises. Philosophically, the technique represents utilitarianism, or more accurately: "Benefit-cost analysis can be regarded as a very special sub-case of the utilitarian ethic where individuals' utility functions are linear with identical constant marginal utilities across individuals and where future utilities are identically discounted" (Schulze and Kneese, 1981, p. 82). Thus, in benefit-cost analysis, resources are valued for their use by humans; efficiency criteria require that resources be taken [involuntarily] from the inefficient and given to the efficient regardless of the circumstances of the individuals involved. If conventional benefit-cost is used as a criterion for decisions, individual rights will be subjugated to the rights of the majority. Furthermore, because conventional benefit-cost analysis uses money measures of income-constrained choices in lieu of actual preferences, benefit-cost analysis weights the values representing the status quo most heavily.

The ethical premises embodied in involuntary reallocations from the inefficient to the efficient [as defined by the status quo conditions] can be acceptable--at least in the sense of a societal consensus--in many situations. However, many policy actors and stakeholders--in particular, those who espouse sustainable development concepts--reject economic efficiency as a policy criterion where major conservation issues are concerned (Mishan and Page). Rejection is more likely if the reallocations are from the poor to the rich or from a future

generation to the present generation (O'Riordan). This alternative ethical premise negates the validity of a benefit-cost analysis as a criterion; if it were to be used to support, say, the continuation of carbon dioxide build-up. Or, for another example, if it justified an economic system that undermined the resource base of developing countries and imposed large involuntary losses on the world's poor.

Also, the conventional neoclassical concept for managing time, the discounting of future benefits-and-cost-streams, leads to what has been termed a "dictatorship" of the present generation (Page, 1977). Discounting can make molehills out of even the biggest mountains. At the usual positive discount rates reflecting the opportunity cost of money, almost any income stream past 20 or 30 years is discounted into irrelevancy. The ethics of the current generation's discounting the net benefits of future generations is questioned by many (Schultz and Kneese; Page, 1977; Page, 1978; and Randall), and rejected by most sustainable development advocates. To quote Gro Harlem Brundtland, Prime Minister of Norway and Chair of the U.N. World Commission on Environment and Development:

> We have adopted a way of thinking which places only a present value on resources. The value of a natural resource is priced by market forces of supply and demand only in a very short-term time frame. That kind of thinking is no longer possible when the depletion of finite resources--including our precious atmosphere--threatens to ruin our long-term life basis. (Brundtland, p. 5)

Pearce (1987a) states the basis for this rejection: intertemporal efficiency requires the maximization of the present value of net gains across generations. Intertemporal efficiency can lead to the extinction of renewable resources and "excessive" use of non-renewable resources. Sustainability concepts on the other hand, imply the general need to protect species diversity and to use non-renewable resources at a rate that allows for substitution of regenerated renewable resources for non-renewable ones. Furthermore, resources should be extracted--according to the sustainable development concept--at a rate equal to or less than the absorptive capacity of the environment to receive the generated wastes. Thus, intertemporal efficiency criteria conflict with intertemporal equity criteria.

Economic Value Concepts

Values in economic analyses are determined by the outcomes that would or do occur in a "perfect" exchange process. The concept of consumer sovereignty is the basis of economic values. These values are assumed to be stable, consistent, knowable, and "right".. The new class of pollutants--toxics in the environment and major environmental disruptions--bring the limitation of these assumptions into sharp focus. First, even if consumer sovereignty is acceptable as an ethical premise, the more complex the decision, and the less of both experience and information attending the potential outcomes of decisions, the more difficult it is to assess economic values on the basis of past choices (Shabman, 1984). Past choices are dependent not only on past preferences, but also on the opportunities associated with prior access to resources or technology. Under some circumstances, small changes in either preferences or opportunities can result in large changes in the choices made (Boulding, 1969). For example, the choices made with respect to, say, the protection of the environment, will be different in the future from those in the past as knowledge is gained, as technology changes, as environmental quality diminishes, as income levels change, and as preferences for environmental quality are altered.

Because of the many technological innovations that have been widely adopted since World War II, society has been forced to manage externalities that are far less tractable than the more conventional problems of noise, congestion, or effluent pollution. These less tractable problems include the disposal of nuclear waste, ozone depletion, and the greenhouse effect. Mishan and Page note that these newer classes of externalities have characteristics that render them less amenable to conventional economic analysis. These characteristics include: society's limited experience with the nature or incidence of the side effects, society's "intelligent apprehension" that the spillovers will take the form of large-scale disasters with possible global dimensions, and society's imperfect understanding of damages that may fall on future generations. Page (1978) refers particularly to the "zero-infinity" dilemma--externalities that pose low probabilities of high consequence [or even catastrophic] outcomes--and therefore pose special challenges for both policy and economics. Faced with such uncertainty, consumers can not be expected to accurately assess the merits of new goods and services such

as chemical drugs and pesticides, nor will consumer experience in purchasing such products result in choices and prices that reflect actual utilities over time (Mishan and Page).

> The question, then, is whether the economist or any kind of scientist can produce meaningful figures purposing to be an economic contribution to the decision making process when the problem under consideration involves spillovers having...[these characteristics]... (Mishan and Page, p. 148)

These environmental risks are often viewed by the sustainable development advocate as emanating from industrial growth and as having tragic consequences (Illich); most do not want to balance these risks with the benefits of economic growth--they want to minimize such risks almost without regard to opportunity costs.

Also, the dominance of a current generations' preferences as proxies for a resources' intrinsic value is rejected by the more extreme sustainable advocates, the so-called "deep-ecologists". In the view of many of these advocates, "something is intrinsically valuable if it is valuable in and for itself--if its value is not derived from its utility, but is independent of any use or function it may have in relation to something or someone else" (Callicott, p. 140). While an argument can be made that existence value [that is, human satisfaction derived from the knowledge that the ecosystem services continue to exist and prosper] represents the "intrinsic value" to which environmentalists refer (Pearce, 1987b), this is a utilitarian view. Intrinsic value to many sustainable development advocates is a biocentric concept recognizing ethical obligations to ecosystems in their own right (Francis).

Indeed, some deep ecologists perceive the anthropocentrism of utilitarian ethics as "speciesism"--used with the same connotation as racism or sexism (Nash)--that is, as repugnant. This extended theory of justice (Pearce, 1987a)--which views nature as having rights--holds that exploiting nature is as wrong as exploiting people.[5] Put simply, nature has a right to exist separate and apart from a utilitarian appraisal by humans.

Thus, the attempts by some economists to produce meaningful figures of the value of non-market goods and services by revealed preference non-market techniques are, from a sustainable development perspective, viewed as absurd and irrelevant:

> How many sparrows are worth a man? No one knows, though I'm sure some clever econometrician will not shrink from the task of imputing shadow prices to sparrows, probably based on the market price of insect repellent that could be saved if there were one more sparrow around to eat the insects. But even if this absurdity were accomplished, it would only be an estimate of instrumental value, not intrinsic value. (Daly, 1987, p. 330).

Externality Concepts

Sustainable development ideology challenges the neoclassical concepts of externality [and by extension, market failure] as well. Externalities are so termed because they are external to the market trading process, but they are not external to the ecological process. Indeed, they are integral and fundamental. From a sustainable development perspective, externalities are the ultimate physical output of the economic process (Daly, 1968). Therefore, maximizing economic output is seen as maximizing externalities as well. However, like neoclassical economists, sustainable development advocates also perceive that externalities arise from institutional failure; current property rights neither provide incentives to protect the environment nor to protect the rights of minority cultures.

The more that "externalities" are viewed as "peripheral, expendable, or of very low priority" (Francis, p. 66) within the dominant economic view of development, the more the deviation from sustainable development beliefs. That is, externalities should be the center of attention in policies directing economic growth, and should assume greater conceptual and practical importance as the "webs of functional interconnectedness among institutions with the functional webs of non-human systems" (Francis, p. 66).

Because the values of today's consumers in an exchange economy do not equate with "true" intrinsic values within the sustainable development ideology, and because externalities are efficiency-derived, static, and distributionally neutral, merely solving for the equilibrium solution of "optimal Pigovian taxes", even in a dynamic framework, is rejected as a valid mechanism for salvaging the efficiency criteria for sustainable development policy design.[6]

An "optimal" externality implies a non-zero level of externality determined as maximizing the net benefits from control (Pearce, 1987a). However, net benefits are determined by individual preferences. Unless these preferences reflect sustainability criteria as well as the infinite marginal prices forthcoming when pollution reaches a level that critically threatens

ecosystem functioning, then sustainability cannot be met. The disruption of ecological services may not be a gradual one because of steadily decreasing environmental quality; the disruption could well be sudden, discontinuous, and catastrophic. Catastrophic changes can occur with no warning; therefore, the "optimal" information requirements are impossible to achieve (Pearce, 1987a). Thus, noting that the assumptions of the neoclassical model are incongruent with the real world, Norgaard (1984) concludes that: "It is ironic that environmental problems in economics are thought of as problems in market failure rather than as evidence of the applicable limits of the market model" (p. 160).

Equilibrium Concepts

The concept of economic equilibrium also does not fit well in the new sustainable development ethic. Mechanistic systems, so predominant in neoclassical economics, are suitable for stable, predictable systems. While equilibrating systems are not required in neoclassical economics (Kaldor), the neoclassical perspective, in general, maintains the assumption of a stable and reversible process (Norgaard, 1985). Most of econometrics assumes the world is inherently predictable (Williams and Findlay). Yet, ecological science and environmentalism increasingly incorporate the concepts inherent in "the science of surprise" that began from theoretical developments in mathematical catastrophe-theory and nonequilibrium thermodynamics (and which can also be found in post-Keynesian economic literature--see Earl and Kay; Ford; Hicks; Shackle). The principles surrounding the "science of surprise" stress the impossibility of prediction and the irrelevancy of probablistic approaches to uncertainty management. These principles mean that the world is one of continuous disequilibrium (Williams and Findlay, III); uncertainty is replaced by unknowability (Ford); exogenous shocks, catastrophes, or surprises replace homostasis. Because the limits to growth for sustainable development advocates are perceived as conceivably resulting in catastrophic and irreversible outcomes, the assumptions of stable equilibrating systems are frequently rejected. These perceptions mean that much of the conventional neoclassical economics paradigm in which the discipline of agricultural economics is rooted is rejected by proponents of sustainable development.

Implications for the Agricultural Economics Profession

There are two broad sets of implications pertaining to the relationship between sustainable development concepts and the agricultural economics profession. The first set encompasses the contributions that agricultural economics can make to sustainable development concepts. The second set involves the contributions of the sustainable development concept to the agricultural economics profession. The first set requires a longer explanation; the second set is more fundamental.

Agricultural Economics Contributions to Sustainable Development Concepts

Agricultural economics can contribute to the debate on sustainability in many ways. However, the concept of sustainable development and the goals it incorporates must be made more rigorous, systematic, and consistent if they are to be amenable to either applied economic analysis or policymaking. Too often moral convictions substitute for rigorous analysis (Redclift, 1987). Furthermore, criticisms of existing modes of thought and methods are not adequate foundation for policy reform. The sustainable development concept lacks an adequate framework to make the concept operational (Norgaard, 1984). Without such a framework, the concept will fail to adequately guide research, policy, or action.

In addition, if they are to achieve a wider audience, sustainable development advocates must better reflect pragmatic concerns that will constrain implementation of sustainable development programs. Existing institutions [and their underlying sources of power] must be either be replaced or remodeled if sustainable development concepts are to be broadly adopted. Without major modifications of existing institutions, many proposals to better integrate sustainable development principles into economic policymaking will remain purely speculative.

For example, currently there are many proposals to redefine net national product accounts so as to reflect a sustainable concept of income (Ahmad, Serafy, and Lutz; Repetto, 1986). As Repetto (1987) notes:

> ...a dangerous asymmetry has arisen in the way we think about and measure natural resources and other assets. Buildings and equipment are valued as productive capital, and are written off

against the value of production as they depreciate. But natural resources are not so valued, and their loss or deterioration entails no charge against current income that would reflect the decrease in future production potential. A country could exhaust its aquifers, cut down its forests, erode its soils, and hunt wildlife and fisheries to extinction, but measured income would rise steadily as these assets disappeared. (p. 170)

Of course, proposals to alter national income accounts did not originate with sustainable development advocates. In the 1970s, for example, the possibilities of altering national income accounts to reflect environmental assessments was well discussed (Olson; Peskin). Yet, unless institutions are redesigned so that national income accounts reflecting environmental assessments can enter decision processes, mere redesign of the accounts will serve little purpose other than measurement of an economy's activity.

Another example of the need for precision in sustainable development proposals involves the issue of compensation of lesser developed countries by the more developed nations. As Redclift (1987) notes, "[f]rom the perspective of a less developed country the emphasis on population and 'global' solutions looks suspiciously like an attempt to evade the issue of the role of international economy in structural underdevelopment... [And it] sometimes creates intense suspicion" (p. 2). The issue of poor countries constraining their development was also considered by Brundtland: "If those of us in rich countries don't realize we need a serious answer to these questions, then the industrializing countries will not feel obliged to join any international accords that will save the white-skinned peoples of the Northern Hemisphere from melanoma" (p. 6). Compensation mechanisms would appear to be crucial.

How are such major institutional modifications to be achieved? Sustainable development advocates owe this question some rigorous consideration. Agricultural economists can, however, provide analytical assistance. Such institutional modification not only suggests major concentration on the implications of existing distributions of power within and among nations, it also suggests the need for extensive analyses of the implications of adopting sustainable development programs. Analyses should include both the first round impacts on environmental quality components and the well-being of the disadvantaged, but they should also address the response of the general economy to the constraints imposed by the pursuit of sustainable development goals.

Thus, agricultural economists can clarify the concept of sustainable development, analyze sustainable development proposals, and design institutions that incorporate sustainable development goals.

Clarifying the Concept. Agricultural economists can assist in clarifying the concept of sustainable development. In such clarification, economic analyses will illuminate some of the contradictions between sustainable development goals. The contradictions are even more evident when sustainable development proposals are removed from a conceptual ideal and are filtered through existing political and cultural realities.

For example, if the extreme sustainable development perspective of biocentricity is adopted, then the concept of opportunity cost [as well as much of the rest of the neoclassical paradigm] appears to be meaningless. If that is the case, then how can redistributions desired by sustainable development advocates be determined in a rational manner? Sustainable development advocates need a realistic answer to this fundamental question.

The less extreme positions of sustainable development advocates also pose practical and conceptual problems that agricultural economists can identify, highlight, and clarify. For example, adoption of a sustainability ethic may well inhibit the very innovation and technological change needed either to assist the disadvantaged peoples of the world or to protect the environment (DeGregori). Ruttan argues, for example, that if the world societies are to realistically expect to meet the food needs of an increasing population while maintaining environmental quality, then technology is needed that improves plant and animal productivity by allowing the substitution of biological technology for chemical technology. Such technologies may well be those advocated as "appropriate technologies"--those that transform the environment for human betterment on a sustainable basis. However, technologies are induced by many factors--including market and political forces (Ruttan). If sustainability means "no growth" and "no growth" policies are implemented, then such "appropriate technologies" may not be forthcoming.

In addition, the relationships between the concept of neoclassical economics and the concept of sustainable development can be thoroughly explored. Not all neoclassical economics are of the "pareto-efficiency" static, equilibrating variety, nor do all natural resource and development economists treat the environment as just another commodity. While, his-

torically, economics has tended to treat natural resources as productive entities [e.g., natural resource economics] separate from the environmental problems of waste generation [e.g., environmental economics], the two fields are increasingly recognized as interdependent. Borrowing concepts from conservationism, ecology and thermodynamics, environmental and resource economics are evolving to a broader consideration of environmental and growth interactions. Several agricultural economists and economists are examining the relationships between the environment and growth, as well as between sustainable development and neoclassical economics concepts. There is even a new professional society, the International Society for Ecological Economics, and a new journal, *Ecological Economics*, addressing these issues. Still, the reality is that this important aspect of disciplinary concern is not overpopulated with students. Furthermore, despite disciplinary attention to sustainability concerns, the more fundamental question remains: can agricultural economics address environmental and growth interactions successfully without breaking free from its mainstream epistemology (Redclift)?

Economic Analysis. Even without a major epistemological reorientation, as agricultural economists we can use our analytical skills to trace out implications of the adoption of sustainable development proposals on a variety of factors.

As agricultural economists, we know that there is no such thing as a free lunch--or, for that matter--a safe lunch. The concept of opportunity cost is very powerful. What are the costs of a more sustainable society? Can society be sustainable at differing levels of population? Can development be sustainable at ever-increasing levels of social prosperity? What are the the trade-offs?

An example drawn from a more extreme sustainable development position, that of self-sufficiency, can be illustrated. Self-sufficiency can be interpreted as being for " no-trade", no market "transactions", and "no competition"--in short, "no change". Indeed, these exact positions make up the manifesto of the Green Party (Anonymous). "A Green Government would replace these false gods [i.e., trade, competition and growth] with cooperation, self-sufficiency, sharing and thrift" (Anonymous, p. 48). The implications of such extreme positions to the functioning of economics and the well-being of all the world's citizens--as well as the environment--demand analytic exposure.

Also, agricultural economists understand the enormity of the transaction costs of orchestrating a coordinated international response to achieve sustainability goals through programs such as the reduction of certain gas emissions or the reforestation of vast areas. We also possess insights on the capability of humans and technology to adapt to changing circumstances.

Institutional Design. Agricultural economists can also assist in institutional design that incorporates sustainable development goals, either by changing existing policies to remove policy incentives for non-sustainable actions or by designing new institutions that promote sustainable development.

There are many examples of existing policies that result either in environmental degradation or in adverse distributional consequences, or both. For example, much has already been discussed with respect to the non-sustainable agricultural practices that have been encouraged by various nations' agricultural policies (see, for example, Daberkow and Reichelderfer; Reichelderfer). These policies are candidates for economic analysis to determine the impact their incentives [and their alternatives] have on both sustainability and income distribution.

One avenue toward achieving sustainable development goals is making modifications of existing institutions. Others include the development of new institutions that alleviate poverty or that minimize the need to manage, control, or damage the environment [without simultaneously creating economic failures]. To the extent that sustainable development ideology is a dominant theme that impacts environmental, developmental, or agricultural policy--and there is increasing evidence that this is the case--the policy economist must be concerned with the implications of the ideology for policy analysis. Policy economics should not be independent of the political expression of society. If the emergent values of society encompass the ethics underlying sustainable development, then there will be occasions where policy economists will need both to abandon adherence to the Pareto optimality criterion and to appreciate the fact that there is a critical distinction between efficiency and social optimality (Bromley).

Neoclassical economists have much to offer in such institutional design. For example, neoclassicalists are particularly adept at designing non-regulatory incentives for bringing

about changes in human behavior to achieve policy goals. Incentive-based policies can lower the cost of reaching a sustainable development goal. Indeed, assuming societal consensus on sustainable development policies, there is a strong rationale for promoting efficiency in reaching these sustainability goals. Agricultural economists and economists can also focus on other means to reduce the cost of sustainability. These include designing policies that lower the costs of investing in the future, that create tenure arrangements that encourage conservation, and that reduce personal and national debt.

Sustainable development advocates emphasize the uncertainty and unpredictability of the future, and they urge caution: society should discontinue any potentially environmentally damaging activity--real or alleged--until conclusive evidence is available on the true environmental costs. Furthermore, rather than address uncertainty by manipulating nature through, say, structural protection from extreme events [such as the building of dams or irrigation systems], they advocate adapting to nature [such as through evacuation or with insurance]. Such an approach suggests institutions must have the resilience and flexibility to manage and adapt to surprises.

We can contribute to institutional development by learning how organizations and cultures develop mechanisms for managing surprising events (Earl and Kay), and we can then apply the information toward improved policy design. We can assist the policy process by providing insights into things that could happen rather than predicting things that will happen (Earl and Kay). By so doing, we can also expand the range of choice available to the policymaker (Shabman, 1989).

Also, agricultural economists can offer the "Safe Minimum Standard" (Ciriacy-Wantrup) as a technique to pursue sustainable goals. The Safe Minimum Standard is a risk-averse, conservative criterion that states society should assure the survival of species, habitats, and ecosystems unless the costs of so doing are "unacceptably large". What is unacceptably large is a social decision; however, the cost can be thought of as how large a "premium" society can afford in order to insure against worse-case outcomes. Thus, the standard does not focus on the benefits of assuring survival--nor on the probabilities of worst-case outcomes. Instead, the focus is on the identification of feasible protection strategies and accurate measures of their attendant costs.

The Safe-Minimum-Standard presumes but does not document benefits; it shifts any burden of proof to opponents of protection strategies, and it turns creative talents to identifying least-cost-protection alternatives. For example, the Safe-Minimum-Standard criterion, with respect to biological impacts of development, could mandate the protection of diverse types of habitat. Widespread habitat protection can be thought of as insurance that maintains future options by avoiding decisions that may prove to be irreversible. The Safe-Minimum-Standard strategy also means the protection of some species that may well serve vital functions but are not widely thought of as worth protecting, such as endangered invertebrates.

Because of its one-sided focus on opportunity costs and non-deterministic definition of acceptability, the Safe-Minimum-Standard strategy may well fall short in the neoclassical economics arena. It also may fall short in sustainable development circles because it allows for development if the opportunity costs forgone are determined to be high. The assumption implicit in Safe-Minimum-Standard procedures that worse-case outcomes are, in some sense, predictable, is also rejected by many sustainable development advocates. Nonetheless, the Safe-Minimum-Standard concept is due more attention in the light of evolving interest in sustainability. Agricultural economics provides the tools to estimate opportunity costs and to assist in focusing the policy debate on opportunity costs as part of the definition of "acceptable" social risks.

Sustainable Development Contributions to Agricultural Economics

The larger challenge to our discipline is not clarifying sustainable development concepts and their relationships to our discipline nor analyzing or participating in the design of institutions to reflect sustainability goals. The larger challenge to our discipline posed by the sustainable development theme is the reconsideration of questions that neoclassical economists have tended to neglect. What are the fundamental causes and dynamics of economic growth in society? What are the relationships between economic growth, natural resources, environmental quality, and human welfare? Is discounting an appropriate means of analyzing resource use in the future? Do resources other than the human mind matter? What are the distributional implications of policies?

These questions are not new to economics. The physiocrats believed natural resources were the fundamental force empowering economic growth and that human societies should live in harmony with the laws of nature (Oser and Blanchfield). The marginalists were preoccupied with questions relating to human welfare distribution and social reform (Cooter and Rappoport). However, the sustainability concept is not a mere resurrection of old classical themes. New concepts from ecology, non-equilibrium thermodynamics, and mathematical catastrophe-theory are strongly influencing perceptions. While these same influences are modifying some contemporary economic perspectives, a coherent, comprehensive integrated model of economic and environmental interaction does not yet exist (Barbier). Precious few models incorporate assumptions that are appropriate for the investigation of the sustainability of economic development (Norgaard, 1984). Even the institutional school, which has long been interested in the role of institutions in achieving change (Klein), has tended to emphasize institutions apart from nature (Norgaard, 1984).

The traditional assumptions of the neoclassical model were adopted to facilitate all investigation of market transactions. The basic assumptions of the neoclassical framework do not fit the natural world. Nor do the main questions of inquiry of the neoclassicalists require such a fit. The assumptions of divisible resources that can be owned, the concept of a continuum of reversible stable equilibriums, and the neglect of feedback from the natural world to economic systems within the neoclassical model make powerful predictors of many economic system responses (Norgaard, 1985). These assumptions, however, are inappropriate for many of the questions asked by sustainable development advocates.

There are at least two possible responses to such omissions--other than ignoring them. The first response is to deliberately consider the environment within the neoclassical paradigm as is done by the new field of ecological economics (see Pearce, 1987a, 1987b). The second response is to abandon a unitary neoclassical paradigm (Redclift, 1987).

This second response challenges us to consider alternative questions, to explore alternative economic and non-economic paradigms, and to gather new insights. That is, neither the neoclassical nor the sustainable development perspective is right or wrong. They are directed at different questions. The sustainable development concept can be our catalyst to

look beyond the boundaries of the neoclassical model and to adopt a more pluralistic view (Norgaard, 1985). We are challenged to push the frontiers of our understanding.

A more pluralistic perspective would also enhance agricultural economists' effectiveness in the policy process. In almost all policy debates--both domestic and abroad--many perspectives and ideologies are represented. Disciplinary arrogance can be our worst enemy in such settings. Close-minded adherence to our ideological convictions can be self-defeating; on the other hand, open-mindedness can provide us with new insights and effectiveness (Shabman, 1989). As Klamer and McCloskey succinctly perceive:

> Economics is such a sweet discipline, such a beautiful model for social thinking, that it is a shame that most thoughtful people, irritated by the cultural barbarism of its practitioners, write it off as nonsense. (p. 4)

Conclusion

O'Riordan observes that "sustainability appears to be accepted as the mediating term designed to bridge the gulf between 'developers' and environmentalists. Its beguiling simplicity and apparently self- evident meaning have obscured its inherent ambiguity" (p. 30). The ambiguity makes it exceptionally difficult to analyze its implications to the agricultural economics profession. Yet, the concept appears to be gaining disciples and is influencing politics and policies both in the the United States and abroad. Furthermore, as an alternative belief system, it challenges many economic concepts, tools, and assumptions.

The sustainable development concept warns us as agricultural economists that if we cling too tightly to conventional neoclassical concepts, we are in danger of trivializing important global problems. We should order and examine the conceptual bases of sustainable development concepts, and explore conflicts with traditional economic approaches. We should give more attention to the interrelationships among [and evolutions of] economic and ecological systems. Furthermore, if an investment is made in a more coherent theory of sustainable development, the theory can provide a guide to research, policy, and action that may indeed lead to an improved world. Some progress is being made with respect to these issues, but

there is justification for broader participation and broader reflection on the challenges posed by the sustainable development concept to our profession.

Footnotes

[1] Daly (1987) distinguishes between the concepts of economic growth and economic development. "By growth I mean quantitative increase in the scale of physical dimensions of the economy.... By development I mean the qualitative improvement in the structure design, and composition of physical stocks and flows (p.323)." The distinction is important because biophysical and ethicosocial limits constrain growth but not development. In this paper, however, it is not necessary to make this distinction, so I do not differentiate between the two terms.

[2] Physical limits to growth have been the concern of many philosophers and economists throughout time, such as Malthus, Ricardo, and Mill. The concept, however, was put in policy by Progressive Conservationists.

[3] Barnett and Morse were not insensitive to concerns about environmental quality. Indeed, they posed the issue: "An open question is whether...[industrial nations] have learned how to maintain social progress, to continue improving the quality of life, to avoid qualitative diminishing returns." However, they did not dwell on pollution issues.

[4] This section and the one following draw heavily from Batie and Shugart (1989).

[5] Nash (1989) notes that two of the more influential books affecting American ethics were Harriet Beecher Stowe's *Uncle Tom's Cabin* and Rachel Carson's *Silent Spring*. The first gave the message that blacks are not commodities to be exploited; the second gave the same message with respect to all life-forms.

[6] The rejection of taxes as a solution does not mean that taxes to internalize the costs of pollution would not reduce incidences of pollution. But the adequacy and legitimacy of taxes are seen to diminish as the scale and type of problems move from localized nuisance-type of taxes to global large-consequence environmental degradation such as ozone depletion.

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