The Evolution of Sustainability

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Abstract *Six separate but related strains of thought have emerged prominently since 1950 in discussions of such phenomena as the interrelationships among rates of population growth, resource use, and pressure on the environment. They are the ecological/carrying capacity root, the resources/environment root, the biosphere root, the critique of technology root, the "no growth"/"slow growth" root, and the ecodevelopment root.*

Each of these strains of thought was fully developed before the word "sustainable" itself was used. Many of the roots are based on fundamentally opposing assessments of the future of mankind. Many of the roots, such as the ecology/carrying capacity root, are based on physical concepts, and they exclude normative values. Others, such as the ecodevelopment root, include such values as equity, broad participation in governance, and decentralized government.

When the word "sustainability" was first used in 1972 in the context of man's future, in a British book, Blueprint for Survival, *normative concepts were prominent. This continued to be the case when the word was first used in 1974 in the United States to justify a "no growth" economy.*

"Sustainability" was first used in a United Nations document in 1978. Normative concepts, encapsulated in the term "ecodevelopment," were prominent in the United Nations publications.

After about 1978, the term "sustainability" began to be used not only in technological articles and reports but also in policy documents culminating in the use of the term in the report of the summit meeting of the Group of Seven in 1989.

The roots of the term "sustainability" are so deeply embedded in fundamentally different concepts, each of which has valid claims to validity, that a search for a single definition seems futile. The existence of multiple meaning is tolerable if each analyst describes clearly what he means by sustainability.

Keywords: sustainability, environment, ecology, development, resources, carrying capacity, eco development

Part 1. Introduction

A. The Purpose of the Paper

There is a continuing search for a set of ideas that can serve as a framework for thinking about the long-range future of both industrialized and the less-developed countries. In this search, concepts emerge, become prominent or even dominant for a time, and then decline. At any given time, there is a mixture of new ideas accepted by few people, dominant ideas that form the major base for conventional wisdom, and older ideas whose force is waning. No doctrine, or set of doctrines, has emerged as the enduring light to illuminate the past and guide the future. In recent years, one of the central ideas advanced as a key to sound policy for all

nations is sustainability. That is, put in oversimplified terms, the wisdom of current policies and of proposed actions should be assessed in terms of their full long-range effects. This is not a new idea, but in a remarkably short time it has evolved from a concept put forward by a few scholars to a widely accepted and influential idea in the continuing debate over the future of the world.

But while the word "sustainability" is now widely invoked to justify action or lack of action, there is as yet no consensus on the precise meaning of the term. This is in large part because the term has roots in a number of equally valid strains of thought that are not only widely diverse but also incompatible. This paper is intended to demonstrate that there is not, and should not be, any single definition of sustainability that is more logical and productive than other definitions. The central point of the paper is that those who use the term "sustainability" should always state precisely what they mean by the term. This approach, as contrasted with what I consider a misguided search for the "proper" definition, has the potential of furthering productive work while avoiding needless controversy.

The intellectual and political streams of thought that have molded concepts of sustainability include the conservation movement that was most influential early in the 20th century; the later environmental movement, domestic and international, that first became a powerful force in the 1960s and early 1970s; the various versions of the "no growth" philosophy that emerged in the 1970s; the discipline of ecology, the counter-technology movement; the resource/environment concept; and the global model approach. Each of these threads of thought is treated separately in Part II to provide a framework for discussion. However, they are in fact intertwined. Whether a given conference, document, analysis, or report should be put in one category or another is often a somewhat arbitrary decision because each of them generally springs from more than one source.

Finally, the literature relating to sustainability is so voluminous that full analysis is not practical. And if it were practical it would probably not be worth the effort. Instead, the aim of the paper is to identify the main streams of thought by reference to some of the most significant documents in enough detail to demonstrate the essential thesis of the paper.

In this connection, primary reliance on what might be called the "formal" or "official" literature may understate the significance of the informal, grass roots, alternative, anti-establishment papers and books. Many of these have not survived the test of time. However, taken as a whole they have been a useful source of ideas. They have raised issues that were widely ignored and that have found their way into the mainstream of thought. The importance of energy conservation and of primary attention to the quality of life, as opposed to material growth, are cases in point.

B. Sequences and Cycles of Emphasis

Concerns for the viability of the planet have gone through a number of phases since World War II.[1] Immediately after the war, the possibility that the resource base would not be adequate for continuing expansion of the economies of the

industrialized countries took the center of the stage. This concern was replaced by the successor to the conservation movement — the environmental movement of the 1960s and 1970s. Over those years, concern for the quality of the environment overshadowed concern for the quantity of resources. Initially, the environment was defined primarily in terms of the maintenance of amenities, recreational space, and aesthetic values in industrialized countries. Later the environment was defined more broadly.

The dramatic findings of the succession of reports stressing the potential problems facing the planet generated strong reactions. *Silent Spring* (1962) was followed by a large number of articles declaring that Rachel Carson's concerns over the adverse effects of pesticides were exaggerated and even unwarranted. *Limits to Growth* (1972) was sharply criticized as being based on untenable assumptions that predetermined the prophesies of catastrophe (See, for example, Cole et al. (1973) *Models of Doom, A Critique of the Limits to Growth*). *The Global 2000 Report to the President* (1982) was followed in 1984 by the *Resourceful Earth* (Julian Simon and Herman Kahn [eds.]), "a devastating indictment of all doomsday books and also the most scientific inquiry into the future ever organized" (jacket blurb). *Resourceful Earth* was in turn criticized in a number of reviews for distorting *Global 2000*.

Such starkly opposed views of the future of the world have deep political and ideological origins. By and large articles, books, and reports that see current and future dangers, and that advocate action to deal with them, are liberal. Those who view such analyses as exaggerations and such prescriptions as unneeded and harmful are conservative. The Carter administration commissioned and endorsed *The Global 2000 Report to the President* (Council on Environmental Quality, 1979). The Reagan administration disowned it.

In addition, reactions to different views of the future of the world are influenced as much by the fundamentally optimistic or pessimistic personalities of prominent authors as they are by facts and objective analyses. Burton and Kates (1962) pointed out in 1965 the existence of such polar and perhaps irreconcilable views of the world:

> In its extreme form, one pole is determinist in its view of nature, Malthusian in its concern with the adequacy of resources, and conservationist in its prescription for policy. The opposite pole is possiblist in its attitude toward nature, optimistic in its view of technological advance and the sufficiency of resources, and generally concerned with technical and managerial problems of development.

Over the years from 1980 to 1990 a number influential reports have taken the position that the world does indeed face very serious short-run and long-run problems derived from the interactions of population growth, resource use, and environmental degradation (Part IV). They differ from the minority view, most strongly stated in the introduction to *The Resourceful Earth*, that the seriousness of all — or nearly all — of these problems has been grossly exaggerated. On the other hand, they take the position that the problems are solvable, given wide understanding of their significance, and strong political leadership. In this they differ from those prognoses, such as *The Limits to Growth*, that state the inevitability

of global collapse, and from those analyses, such as *The Global 2000 Report to the President*, that concentrate on describing the problems as contrasted with emphasis on what should be done.

For example, Lester B. Brown (1981) outlined what he considered to be the prime characteristics of such a society and how it might be attained. His conclusion was that the transition would be difficult, uneven, of long duration and painful, but possible.

The World Resources Institute report *The Global Possible* (1985) stated a consensus reached by an international group of experts, political figures, administrators of national and international agencies, non-governmental organizations, and industrialists. The convenors of the group were Robert O. Anderson, Robert S. McNamara, Matthew Nimitz, Soedjatmoko, Maurice F. Strong, M.S. Swaminathan, and Russell E. Train. Quotations from the overview of the report epitomize the viewpoint of the group:

> Population can be stabilized . . . This will happen only if the poorer half of the world's people . . . can find productive jobs and access to land, credit, and training. . . . Agricultural production can expand to meet all future demands. . . . But this will happen only if farming systems and agricultural technologies that match land capabilities are developed and explained to the world's farmers. . . . Economic growth can be sustained with markedly lower energy input. . . . This will happen only if energy prices and policies are structured to realize the enormous potential that exists for further energy conservation and improved efficiency in energy use.

Part II. The Roots of Sustainability

Six separate but related strains of thought have emerged prominently since 1950 in discussions of such phenomena as rates of population growth, resource use, and pressure on the environment. Each of these strains of thought has, in recent years, contributed to current concepts of "sustainability." All were developed quite fully before the word sustainable was used. The diversity of the roots of sustainability accounts for the fact that the term has no clearly defined, widely accepted meaning. (Brown, B.J. et al. have analyzed current concepts of sustainability, as contrasted with the historical approach of this article, in "Global Sustainability: Towards Definition.")

A. *The Ecological/Carrying Capacity Root*

One, and arguably the most significant, root of concepts of sustainability is found in ecology. Long before the term sustainability was used in the context of the interrelationship between man and nature, ecologists insisted that failure to take fully into account the full long-term consequences of human activities — particularly those related to "development" — would lead to disaster. For example, the report of a 1988 conference on ecology and international development stated that:

> little concern had ever been given to anticipating ecological costs and side-effects, to say nothing of having such factors serve as inputs to decision-

> making in development projects. . . . One of the central elements affecting the productivity of any region — the specific character of its ecosystems — had almost always been ignored. As a consequence, the bulk of international development to date has often been destructive. (Farrar and Milton. *The Careless Technology,* 1972).

The concept developed by ecologists that a given ecosystem can provide a sustenance for a maximum number of given species, and that exceeding that maximum will set in motion a chain of events cutting the population back to or below the maximum is the heart of "carrying capacity." This definition by Riddell in *Ecodevelopment* (1981) is typical:

> Carrying capacity is the population (human and animal) that can be sustained by an ecosystem. Carrying capacity is most readily understood when it is expressed in terms of 'standard stock units' (each unit being 500 kg live weight) of animal per square kilometer. Overpopulation occurs when carrying capacity is exceeded.

All the reports dealing with ecology and carrying capacity share an important characteristic. They are concerned with physical phenomena, such as land availability, population levels and growth rates, environmental degradation, etc. They have not been, until quite recently, concerned with such questions as the equity of economic systems, or the role of social and cultural traits as influences on carrying capacity, or influence of technology.

These concepts of both ecology and carrying capacity are intertwined with critiques of technology that constitute another root of sustainability.

B. *The Resource/Environment Root*

During the decade after the end of World War II, a number of influential books raised questions about the capacity of the earth to sustain the rapidly growing population.[2] Among these were Vogt, W. (1948) *The Road to Survival*; Osborne, F. (1948) *Our Plundered Planet*; and Brown, H. (1954) *The Challenge of Man's Future.*

A particularly influential book was *Man's Role in Changing the Face of the Earth* (University of Chicago Press, 1956). It was the outcome of an international conference convened by the Wenner-Gren Foundation. Fifty-two essays on various aspects of resource use, population growth, and environmental change, plus commentaries, comprise the 1,200-page volume. Every aspect of current discussions of sustainability was mentioned, but the term itself did not appear. Samuel Ordway, in a particularly relevant essay entitled *Possible Limits of Raw Material Consumption* (pp. 987–1009), sketched a theory of the limit to growth that foreshadowed the 1972 Meadows *Limits to Growth* book:

> The theory of the limit to growth is based on two premises:
>
> 1. Levels of human living are constantly rising, with mounting use of physical resources.
> 2. Despite technological progress we are spending each year more resource capital than is created.

> The theory follows: If this cycle continues long enough, basic resources will come into such short supply that rising costs will make their use in additional production unprofitable, industrial expansion will cease, and we shall have reached the limit of growth.

In the late 1960s and during the decade of the 1970s emphasis shifted from concern over the adequacy of resources to maintenance of environmental quality. This concern, which assumed the dimensions of a crusade, had deep social causes:

> The environmental movement of the 1970s expressed frustration with the workings of big business, big government, and large universities; it apparently was in part a reaction to the material affluence of the time, to the moral and social impacts of the Vietnam War, and to the other stresses in the social fabric.[3]

These social pressures resulted in a flood of local, state, and federal laws and regulations dealing with such things as air and water quality, preservation of wilderness, subsidy of pollution-abatement works, and income tax incentives to use solar energy. The National Environmental Policy Act (NEPA) was put on the books and the Council on Environmental Quality and the Environmental Protection Agency were established.

Concern over deterioration of the environment, shared by Western European countries and Japan, was instrumental in leading to the 1972 U.N. Stockholm Conference on the Human Environment. This conference, together with the preparatory sessions and subsequent meetings, was in turn the forum at which concern for environmental degradation in developing countries was expressed for the first time by those countries themselves.

C. *The Biosphere Root*

Concerns over the possibility that human activity can degrade the entire planet were stated by Benjamin Franklin: "Whenever we attempt to amend the scheme of Providence, and to interfere with the government of the world, we had need to be very circumspect less we do more harm than good." (Smith, 1907). Marsh (1864) developed the same theme in *Man and Nature, or Physical Geography as Modified by Human Action:*

> The scale of change initiated by man is no longer local, but global. The climatic and hydrological effects of deforestation provide an example.

Marsh had no successor until Nathanial Shaler, professor of geology at Harvard, wrote *Man and the Earth* (1905). He was perhaps the first to emphasize the moral obligation of each generation to heed the needs of future generations:

> We may be sure that those who look back upon us and our deeds from the centuries to come will remark upon the manner in which we use our heritage, and theirs, as we are now doing, in the spend-thrift way, with no care for those to come. (p. 1)

What is now called "intergenerational equity" was thus spelled out more than 80 years ago, and further digging would no doubt push the first statement of the idea still further into the remote past.

The central theme first expounded by Marsh – the increasing scale of man's role as an agent of global change – was reiterated by a few farsighted scholars between 1924 and 1945. For example, Alfred Lotka, an American biophysicist, wrote in 1924, "Economically we are living on our capital; biologically we are . . . throwing into the atmosphere ten times as much carbon dioxide as in the biological process of breathing." (*Elements of Physical Biology.* Williams and Wilkens, 1924. p. 222.)

The view that the earth is fast becoming a closed system was elaborated and expressed vigorously by Kenneth Boulding (1966):

> The closed economy of the future might similarly be called the "spaceman" economy, in which the earth has become a single spaceship, without unlimited reservoirs of anything, either for extraction or for pollution, and in which, therefore, man must find his place in a cyclical ecological system which is capable of continuous reproduction of material form even though it cannot escape having inputs of energy. In the spaceman economy, throughput is by no means a desideratum, and is indeed to be regarded as something to be minimized rather than maximized.

D. *The Critique of Technology Root*

The claim that technology has predominantly dehumanizing and disorganizing effects has provided a central theme for a continuing counter-technology movement. Initially, the movement, led by figures such as Thoreau, was concerned in the United States with domestic affairs. Later, in the late 1960s and the early 1970s the pernicious effects of the indiscriminate export of technologies from industrialized countries to developing countries were stressed.

For example, the Conservation Foundation (1972) sponsored a conference on the ecological aspects of international development. The proceedings appeared in the Book *The Careless Technology: Ecology and International Development.* The 1,000-page volume consists of 50 essays, most of which are case studies of a wide variety of unsuccessful or harmful development projects, plus integrative statements by Russell Train and Barry Commoner. The conference dealt primarily with problems generated by the failure of development projects to take into account the full ecological implications of technological innovations. Only a few cases dealt with problems in industrialized countries – ecological hazards from nuclear power plants, atomic waste disposal at sea, and thermal pollution.

The implications of the case studies were interpreted by Barry Commoner and Lynton Caldwell. Caldwell, in an essay in *The Careless Technology* entitled *An Ecological Approach to International Development: Problems of Policy and Administration,* wrote:

> In many countries today, the life-support system of soil, water, air, minerals and living things is being stressed to a degree that could result in the failure

> of one or more critical components. . . The most widespread cause of ecological bankruptcy may be the gradual wearing out of the environment — the stressing of natural systems beyond their capacity for regeneration. (p. 942)

A large group of analysts has taken exception to the dominant high-energy, high-technology, systems of agriculture in the industrialized countries and to efforts to introduce these systems to the less-developed countries.[4] For example, Gordon Douglas wrote a book (1984), *Agricultural Sustainability in a Changing World Order,* that stressed the importance of maintaining the values of idealized agricultural communities, as expressed by the "alternative" or "radical" agricultural movement. These values include close personal relationships, a sense of duty to nature, justice, and wide participation in the making of social decisions. He suggested that it would be desirable

> to incorporate the notions of justice or equity in the definition of agricultural sustainability. . . . One possibility is to declare as unsustainable any structure of agricultural production which worsens the distribution of income or opportunities or incomes . . . and another might be to judge unsustainable all structures which fail to improve the distribution of opportunities or incomes by a specific degree within a given period of time. (p. 25)

George Rodale, Chairman of the Board of the Rodale Press, has been one of the most vocal advocates of low-technology, low-energy agriculture. For example, the Rodale Press sponsored the Cornucopia Project. This 1981 study of American agriculture, entitled *Empty Breadbasket?*, produced recommendations directed to consumers, producers, distributors, government, and universities and aimed at producing "a food supply culturally, environmentally, economically, and technologically sustainable in respect to production and all other aspects of the food system — including resource inputs, cultivation techniques, processing and distribution." (p. 111)

Some authors have advocated moderate growth and have particularly stressed the significance of technologies for developing countries that are ecologically gentle and adaptable to their economic, resource and social structures. An example is E.F. Schumacher's book, *Small is Beautiful: Economics as if People Mattered* (Harper, 1973). This book played an important role in launching the appropriate technology movement, and it foreshadowed the concept of sustainability.

Kenneth Dahlberg (1987) has elaborated on these themes:

> The war against nature (and ultimately humankind) is already well under way. . . This war against nature is built into the current structures and belief systems of industrial society. . . . It is hoped that the industrial societies will be able to learn and practice the wisdom of millennia of peasants and farmers; that is, that in addition to finding ways to get along with one's neighbors, the ultimate sources of security lie in conserving one's heritage of regeneration — the seed corn.

E. *The "No Growth-Slow Growth" Root*

The extent to which wealth and the accumulation of material possessions should

be a dominant goal for societies has concerned philosophers and theologians from biblical times. The unprecedented spurt in economic growth in the 19th Century based upon the steam engine and capitalism required and generated values, attitudes, and human costs that led many to question the validity of growth as a goal of society. John Stuart Mill (1857) advocated a sustainable economy, although he did not use the word:

> I cannot regard the stationary state of capital and wealth with the unaffected aversion so generally manifested towards it. . . . A stationary condition of capital and population implies no stationary state of human improvement. There would be as much scope as ever for all kinds of mental culture, and moral and social progress . . . when minds cease to be engrossed by the art of getting on.

The "no growth" philosophy has been more recently stated most comprehensively and forcefully in a series of books published between 1971 and 1977. In 1971 and 1972 significant books that advocated "no growth" on somewhat different grounds were published. The first was Nicholas Georgescu-Roegen's (1971) book *The Entropy Law and the Economic Process.* His major theme was that the fundamental laws of thermodynamics made a steady state economy inevitable.[5]

The second was Meadows et al. (1972) *The Limits to Growth.* This book created a strong impression throughout the world. The essential message of *Limits to Growth* was that the world is headed for collapse within a few decades through population growth, depletion of resources, pollution, degradation of the environment, or some combination of these. The impact of the report was heightened by the fact that it was based upon a world model stated in the form of equations that provided the basis for computer simulations of different scenarios. All of them pointed to disaster unless drastic action, including cessation of economic growth, is taken. The authors felt that the probability of effective action was low and that their forecasts were adequately precise:

> We feel that the model described here is already sufficiently developed to be of some use to decision makers. Furthermore, the basic behavior modes we have already observed in this model appear to be so fundamental and general that we do not expect our broad conclusions to be substantially altered by further revisions. (p. 22)

The primary conceptual source to *The Limits to Growth* was the system dynamics approach of Jay Forrester, in which he extended mathematical modeling from relatively simple systems such as cities and industrial enterprises to the globe. Forrester (1971) published his model and conclusions in *World Dynamics.*

Although *World Dynamics* and *The Limits to Growth* can both be properly called extended inquiries into sustainability, the word itself did not appear at all in *World Dynamics,* and it appeared only twice in *The Limits to Growth* and then not as a theme but in an incidental context:

> What will be needed to sustain world economics and population growth until, and perhaps even beyond the year 2000? (p. 45). . . . There would be little point

> even in discussing such fundamental changes in the functioning of modern society if we felt that the present pattern of unrestricted growth were sustainable into the future. (p. 168)

Several critics attacked *The Limits to Growth*, primarily on the ground that the assumptions underlying the operation of the model were faulty and that the faulty assumptions guaranteed the predicted catastrophe. The most carefully worked out criticism, *Models of Doom* (Universe Books, New York, 1973), was written by H.S.D. Cole, Marie Jahoda, Christopher Freeman et al. of the Science Policy Research Unit of the University of Sussex. While the debate generated by *The Limits to Growth* would have been called a debate over sustainability, the word did not appear in *Models of Doom*.

Herman Daly has been a prominent exponent of the "no growth" school of thought through his books *Toward a Steady State Economy* (1973) and *Steady State Economics — The Economics of Biophysical Equilibrium and Moral Growth*, as did Dennis Pirages and Paul Ehrlich (1973) in *Ark II*. The same theme was stressed by Amory Lovins (1977) in *Soft Energy Paths*. This observation by Lovins on energy supply and demand epitomizes the philosophy of those who advocate a reduction in energy use:

> Few people oppose solar energy in its many forms, nor improved energy efficiency, nor the modest and intelligent use of coal under strict environmental controls. If we combine all these measures in the right way, then we shall simply not need most of the big supply technologies debated today — especially the costliest, nastiest, and riskiest ones. It is hard for people who have spent their lives developing such systems to accept the idea that their handiwork is now superfluous; but their devices are clearly too expensive and too dangerous to be suitable toys to gratify even the most deserving technologists. (p. 18)

All of the books in this root have in common a number of assumptions:

- The first is that growth must stop at some point. That is, continuing growth for the indefinite future is physically impossible.
- The second assumption is that a no-growth economy can promote ethical values and superior social goals. In advocating these normative concepts, the "no-growth" school differs sharply from the "carrying capacity" concept.
- Finally, in industrial countries, a reduction in per-capita energy consumption, a shift in sources of energy away from fossil fuel, and towards energy conservation are imperative. Increased efficiency in generation, distribution, and use of energy are also imperative. Indeed, policies and philosophies related to energy are such a prominent element of the "no growth" school of thought — and of other roots of sustainability — that they could be considered as a separate root of sustainability.

While the extreme "no-growth" position as stated by Georgescu-Roegen and Daly has been superseded, at least for the moment, by the idea that sustainable growth is possible and desirable, the "no-growth" doctrine has had some significant consequences:

- The "no-growth" doctrine was influential in grafting normative moral and ethical concepts to the concept of sustainability.
- The "no-growth" proponents directed attention to long-range problems, encouraged new ways of looking at the future, stimulated debate, and encouraged examination of values.

F. *The Ecodevelopment Root*

In 1977, Professor Ignacy Sachs of the Centre International de Recherche sur l'Environment et le Developpement in Paris, wrote, "The Salient Features of Development" (Sachs, 1977). In this essay, Sachs invented the term "ecodevelopment" and defined it as "an approach to development aimed at: harmonizing social and economic objectives with ecologically sound management, in a spirit of solidarity with future generations." However, he did not use the word "sustainability." The contribution of Sachs is significant because it provided the basic rationale for the 1978 UNEP document that marked the first use of the term sustainability in a U.N. document.

Sachs' concept of ecodevelopment influenced not only UNEP but also a number of authors who stressed the importance of normative values in development. For example, Robert Riddell (1981) published *Ecodevelopment, Economics, Ecology, and Development: An Alternative to Growth Imperative.* His approach is epitomized by this passage: "Now that the oil wells are starting to run dry, Northern nations will flex their remaining economic muscle and rattle their nuclear sabres in an effort to capture the precious remainder . . . Ecodevelopment seeks to provide the best material and cultural life continuously sustainable for the desired population" (p. 8). He advocated these actions:

1. Establish an ideological commitment.
2. Sharpen political and administrative integrity.
3. Attain international parity.
4. Alleviate poverty-hunger.
5. Eradicate disease-misery.
6. Reduce arms.
7. Move closer to self-sufficiency.
8. Clean up urban squalor.
9. Balance human numbers with resources.
10. Conserve resources.
11. Protect the environment.

While no other writer has gone as far as Riddell in folding a comprehensive social and political agenda into the concept of sustainability, the central idea that values are an inherent element of sustainability has been advocated by a number of observers.

III. "Sustainability" Emerges and Evolves (1972–1980)

A. *The Ecologist "Blueprint for Survival"*

In 1972 the editors (E. Goldsmith et al.) of *The Ecologist,* a British periodical, wrote

a book *Blueprint for Survival* in which the term "sustainability" first appeared as a major theme:

> The principal defect of the industrial way of life with its ethos of expansion is that it is not sustainable. . . . A growing number of people . . . are more interested in our proposals for creating a sustainable society than in yet another recitation of the reasons why this should be done" (p. 3). . . . *Indefinite* growth of whatever type can not be sustained by *finite* resources. (p. 6) [italics in original.] (p. 21)

Blueprint for Survival depended heavily on MIT-sponsored report, *Man's Impact on the Global Environment,* by members of the Study of Critical Environmental Problems (SCEP), for facts. However, the tone, style, and conclusions on *Blueprint* differed markedly from the MIT report, and the MIT report did not contain the word "sustainability." Eric Ashby (1978) wrote this appraisal of *Blueprint*:

> The data in the *Blueprint* were taken largely from the SCEP Report, but unlike that report the *Blueprint* was both utopian and apocalyptic, and it rang the doomsday bell with frantic vigor. It used sensational and emotive prose to get its message across. On practically every page there were assertions repugnant to the rational reader: plunges into naive fallacies; innuendoes; patently incorrect assertions; and statements unsupported by published and accepted evidence. The *Blueprint* was lavish with prescriptions of what must be done, with scarcely any reference to what was being done, and more important, to *how* it was being done."[6]

The fact that "sustainability" was first stated as a major goal of the society in the polemical rather than the academic literature has contributed substantially to the development of different concepts of sustainability.

B. *The International Union for the Conservation of Nature (IUCN), 1972*

Since 1948, the International Union for the Conservation of Nature (IUCN), based in Switzerland, has campaigned vigorously for protection of the environment in both developed and developing countries. In its 1972 *Yearbook* (p. 1) is found one of the first instances of the use of the word "sustainable" in the context of the environment:

> Conservation in the sense used by IUCN means management "of the resources of the environment" so as to achieve the highest *sustainable* quality of human life. [Emphasis added.]

This sentence was repeated in the 1973 and 1974 issues of the IUCN *Yearbook,* but not in later issues. The IUCN *1972 Yearbook* could have picked up the word sustainable from *Blueprint for Survival,* but this is not certain.

C. *The Woodlands Conferences and Prizes*

George P. Mitchell, a Houston geologist and business man, became interested in the early 1970s in the long-term implications of population growth, resource

depletion, urbanization, and environmental deterioration. From this interest there emerged a series of Woodlands Conferences, which he financed, devoted to discussion of the relevant issues and to dissemination of the results of the discussions.

The document prepared in 1974 for the first planning sessions for these conferences used the word "sustainability" for the first time in the United States in the context of development. This was two years after the Stockholm Conference and the year of the Cocoyoc Symposium (see the following section).

The program of conferences was based on five principles, the first of which is particularly significant: "The program should not attempt to prove or disprove the limits-to-growth thesis, but should search for the policy implications of a societal transition from growth of population, materials use, and energy consumption *to steady state.*"[7] [Italics added. Note that the definition of sustainability is in terms of attaining a steady state.]

The planning meetings in 1974 led to Woodlands Conferences in 1975, 1977, 1979, and 1982. In turn, the conferences led to books that were among the first to use the word "sustainable" in their titles:

1977. Dennis Meadows. *Alternatives to Growth I: A Search for Sustainable Futures.*

1979. James C. Coomer. *Quest for a Sustainable Society.*

1979. Harlan Cleveland. *The Management of Sustainable Growth.*

These books were "among the first" because another 1977 book not prepared under the Woodlands auspices contained "sustainable" in its title. In 1977, Dennis C. Pirages edited a book entitled *The Sustainable Society, Implications for Limited Growth.* It included chapters on: *A Social Design for Sustainable Growth, Political Change and the Sustainable Society, Social Innovations Required for a Sustainable Society.* In the introduction to the series of essays Pirages wrote, "The subject matter of this volume is the nature of the "transition" from societies in which rapid growth may well be the exception rather than the rule."

It is worth noting that *The Sustainable Society* (1977) followed by three years the appearance of the term in the Woodlands Conference papers, coincided with the publication of Meadow's book, and preceded by one year the first appearance of "sustainability" in a U.N. document.

In an earlier (1973) book (Pirages, D.C. and Ehrlich, P.R., *Ark II*), Pirages treated many of the themes repeated in the later book. However, the 1973 volume stressed "no growth" rather than "sustainable growth," and the earlier book did not contain the word "sustainable."

In addition to the Woodlands Conference, Mitchell established the Mitchell prize in 1974. The statement announcing the establishment of the prizes said that they would be awarded:

> to individuals demonstrating exceptional creativity in the design and description of workable strategies to achieve sustainable societies. The Mitchell Prize awards strive to encourage creative, constructive thinking and public discussion of sustainable societies in which social and economic progress has been made consistent with the world's known resources base.[8]

In summary, it is clear that planning documents for the Woodlands Conferences and for the Mitchell prize used the term "sustainability" for the first time in the United States in connection with economic and social policy, and that sustainability was defined in terms of a transition from growth to a steady state.

The first book resulting from the Mitchell program, Dennis Meadows' *Alternative to Growth — A Search for a Sustainable Future* (1977), was devoted to exploring further the issues involved in the transition to a steady state. He accepted Herman Daly's 1973 definition of a steady state: "By 'steady state' is meant a constant stock of physical wealth (capital) and a constant stock of people (population)." Meadows noted that:

> This definition clearly states the necessary conditions for a *steady state*, but it does not specify the attributives of a *sustainable state* — that is, one consistent with global limits and also acceptable to the broad spectrum of individuals and institutions whose sustained compliance with diverse ethics, laws, and norms is required to make any social system viable. [Italics in original]
>
> The goal of a sustainable steady state forces attention toward ways of making zero material growth consistent with equity, personal liberty, cultural progress, and the satisfaction of basic physical and psychological needs.

In short, Meadows accepted the idea of the desirability and even the necessity of a no-growth economy, but he added criteria, which, in his judgment, must be met if the no-growth economy is to be sustainable.

It is significant that these first uses of the word "sustainable" in the United States were not narrow, ecologically bound concepts but rather statements of a broad political and ethical philosophy justifying a "no-growth" society. This broad philosophy was not grafted to an ecological concept. Instead, the ecological component was an integral part of the broader philosophy. This point is particularly significant because it influenced later concepts of sustainability developed by UNEP.

Later Woodlands Conferences and Mitchell prizes did not stress attainment of a steady state as an imperative goal. For example in the 1979 volume, *The Management of Sustainable Growth* (Harlan Cleveland, ed.), stress was placed, as the title indicates, on growth and not on attainment of a steady state. Lincoln Gordon contributed a chapter to the book containing a section entitled, "The Concept of Sustainable Growth." He outlined for the first time some concepts that were elaborated as central points in later discussions of sustainability. He noted that:

> Sustainable growth implies compatibility with limitations of natural resources and environmental absorption capacities. It may involve issues of intergenerational equity. And insofar as constraints on growth are institutional and attitudinal, it raises fundamental questions of differing valuations placed on economic growth by different cultures and groups within a given culture. It is easy to point to unsustainably high rates of growth in specific environments. The most obvious example involves drawing on renewable resources beyond their rates of potential regeneration. . . . But when it comes to raw materials the human record of ingenuity in technology and substitution suggests that a general policy of self-denial by the present generation

> would be fruitless. . . . Therefore we may be well advised to focus on the policy implications and the management problems of alternative rates and patterns of growth without pressing further for an unambiguous and elusive definition of sustainability. (pp. 276–278)

In conclusion, the fact that "sustainable" appeared in the titles and texts of some books early in the 1970s should not conceal the fact that a spate of books on the future of mankind and the earth published at that time did not mention "sustainability." The term was just emerging. It was used infrequently in specialized literature and not at all in widely read books, magazines, and newspapers.

D. *The Magnuson Act,* 1976

The term "sustainability" was first used in connection with the capacity of ecosystems to support animal population. The term was applied initially to species of fish, then to marine life in an ecosystem and then to wildlife. In 1976, it actually appeared in a Federal Statute — the Magnuson Fishery Conservation and Management Act. In this law, the Congress found (Sect. 2[a], [5]) that, "Fisheries can be conserved and maintained so as to provide optimum yields on a continuing basis." One of the purposes of the Act is (Sect. 2[b], [4]) "to provide optimum yield from each fishery." Finally, the Act defined "optimum" (Sect. 3 [18], [b]) as: "The amount of fish which is prescribed as such on the basis of the *maximum sustainable yield* from such fishery . . ." [emphasis added]. This incorporation of "sustainability" into U.S. law came a year before the first book with sustainability in the title was published and two years before the term was first used in a U.N. document.

It should be noted that the concept of sustainability that appeared in the 1976 fisheries act was narrowly ecological, whereas those who first used the term in a development context used it to describe something entirely different — a "no growth" economy.

E. *U.N. Conferences and Reports*

The influence of U.N. conferences and reports on the emergence of "sustainability" can be traced through two phases. The first was a period between 1968 and 1976 when ideas related to sustainability emerged, but when the word itself was not used. In the second phase, beginning in 1978 the word "sustainability" was used.

1. The Emerging Ideas

During the 1960s the dominant view of developing countries towards concern for protection of the environment was skepticism or hostility. Deterioration of the environment was at that time viewed primarily as industrial pollution that degraded the quality of life in industrialized countries. The developing countries tended at that time to equate industrialization with development, as did the economic assistance agencies of the industrialized countries. The developing countries were prepared to accept industrial pollution as a cost of development, and they viewed the costs of efforts to reducing industrial pollution as barriers to development.

This reasoning was challenged by a series of international meetings. To prepare for the 1972 U.N. Stockholm Conference on the Human Environment, the secretariat convened a seminar in Founex, Switzerland, in June 1971. At this seminar, the definition of environmental concerns was broadened to include development-related problems such as resource deterioration, squalid housing conditions, and lack of sanitation. Most significantly, the report of the seminar redefined the meaning of environmental deterioration in developing countries:

> The major environmental problems of developing countries... are predominantly problems that reflect the poverty and the very lack of development of their societies. Not merely 'the quality of life' but life itself is endangered by poor water, housing, sanitation and nutrition, by sickness and disease, and by natural disasters.

This wider concept of environmental problems was accepted by the 1972 Stockholm Conference.

The 1972 Stockholm Conference was most notable for swinging world opinion to the view that environmental degradation is a serious threat to the development process and to the well-being of hundreds of millions of the poorest people. The conference was instrumental in institutionalizing environmental concerns through establishment of the United Nations Environmental Program (UNEP).

The Stockholm Conference was followed in 1974 by a Symposium on Resource Use, Environment and Development Strategies held in Cocoyoc, Mexico. This symposium followed the 1973 oil crisis and the growing pressure for a new International Economic Order exerted in the sixth session of the U.N. General Assembly. As a result, the report of the symposium wove together the emerging ideas on the significance of the environment for developing countries and new concepts of the goals of development. Broadening concepts of environmental degradation from a set of problems generated by urban industrialization in developed countries to problems generated by rural poverty in developing countries led to fundamental changes in the rationale and the content of development programs.

The U.N. meetings represented both a reaction to mounting public concern over environmental issues and a stimulus to further debate and action by an impressive array of both governmental and private institutions.[10]

2. The Word Appears in the U.N., 1978

In 1978, UNEP reviewed changes in thinking and action related to the environment and development and published a document based on the UNEP 1978 report, *Review of the Areas: Environment and Development, and Environment Management.* The report listed seven causes of environmental degradation, noting that:

> A third type of threat to environmental quality arises from the satisfaction of immediate requirements (often non-essential) at the expenses of long-term ones (often basic). *Sustainable development means that the needs of present and future generations must be appropriately reconciled.* [italics added]

After listing these causes, the Review proceeded to spell out a UNEP philosophy

for dealing with them. In doing so the concepts of ecodevelopment as propounded by Sachs (see the preceding sections) were drawn upon heavily:

> Ecodevelopment aims, in particular, at sustaining the yield of renewable resources and controlling the depletion of non-renewable resources so that they benefit the community as a whole. Institutionally, ecodevelopment requires close involvement of the population in decision-making. . . . All such proposals are, of course, normative in character. Environmental soundness, as described earlier, requires that development be sustainable over the long term, that the greatest number of options be kept over the long term, that the greatest number of options be kept open for the future, and that the physical environment be protected. The social aspects, which are directly related to environmental factors, emphasize the importance of equitable access to opportunities and resources, use of local resources, and public participation."

This was the first time that the word sustainable appeared in a U.N. document, and it is important to note that it was used in the context of ecodevelopment. The U.N. formulation of "ecodevelopment" stressed the significance of equitable distribution rather than "no growth," and in this respect differs from the concept developed in the United States. In addition, the U.N. formulation gave greater emphasis to the concerns of the developing countries, while the "no growth" school in the United States concentrated on the developed countries.

While the developing countries found it possible at the Founex Seminar and the Stockholm Conference to define environmental protection in a way that appealed to them, there was no possible formulation of a "no-growth" philosophy that they could find acceptable. Accordingly, when the term "sustainability" was used in U.N. documents it carried no trace of the American "no-growth" school of thought.

In short, in England, in the United States, and in the U.N. "sustainability" emerged in the context of broad social, economic, and political goals, rather than in the context of more narrowly defined resource management and ecological concepts.

Part IV. Sustainability Becomes Popular, 1981–1988

In the 1980s the term "sustainability" moved out of the confines of books with limited circulation, technical articles and reports into one wider popular sphere and into the operational planning of important agencies. Non-governmental and governmental agencies have played different roles as sustainability has become popular. Non-governmental organizations have been a source of ideas and concepts related to sustainability. They have popularized the term and stimulated debate. They have also effectively urged governmental agencies, both national and international, to pay more attention to the sustainability of the projects that they finance or operate and to the policies of governments towards sustainability. Governmental agencies have tended to react to externally generated ideas and to adapt these ideas to their policies and actions.

A. *Non-Governmental Entities*

1. The Worldwatch Institute

The Worldwatch Institute, a non-profit organization headed by Lester R. Brown, has been a major force in popularizing the idea of sustainability. It published the book, *Building a Sustainable Society* in 1981. Thereafter it has published, beginning in 1984, an annual volume, *State of the World*, that explains in terms understandable to the layman various aspects of sustainability. The 1987 *State of the World* issue, with the sub-title, "A Worldwatch Report on Progress Toward a Sustainable Society" has sold more than 200,000 copies on the world-wide market. The volume has been published in Spanish, Arabic, Chinese, Japanese, French, German, Italian, Russian, Indonesian, Polish, Hungarian, and Thai.

2. The World Resources Institute

The first substantial task of the World Resources Institute, established in 1982, was to take a fresh look at global resources and population problems and opportunities. This was done by commissioning papers by prominent scholars and by convening an international conference. The report of the conference, *The Global Possible* (1985), not only stressed the concept of sustainability but elaborated a definition:

> At the core of the idea of sustainability. . . is the concept that current decision should not damage prospects for maintaining or improving living standards for the future. . . . Sustainable development is a three-legged stool. Its bases are scientific realities, consensus on ethical principals, and consideration of long-run self-interest. There is broad agreement that pursuing policies that impair the welfare of future generations is unfair. . . . Poverty, which denies people the means to act in their own, long-run interest, underlies the deterioration of resources and the growing population pressures in much of the world and affects all. (p. 11)

The *Global Possible* was followed by Norman Myers' 1987 monograph commissioned by WRI, *Not Far Afield: U.S. Interests and the Global Environment.* Sustainability is a central theme of this work:

> We can define sustainable development as the permanent process for generating economic benefits while maintaining the natural-resource base. While environment degradation is common in the temperate zones, the greatest damage is being done in the tropical Third World, where the need for sustainable development is greatest. (p. 4)

3. The Indian Science Congress Association

An example of early advocacy of the validity of the concept of sustainability by a non-governmental entity is provided by the Indian Science Congress Association. Theme of the 1985 annual meeting of the Association was *Science and Technology in Environmental Management,* and the presidential address by T.N. Khoshoo was entitled *Environmental Priorities in India and Sustainable Development.* The key point of the address was: "Time has come when *sustainability in*

development has to enter in our planning process as one of the basic and permanent objectives." [Italics in original]

B. *The Independent International Study Groups*

Two independent international study groups have made important and quite different contributions to defining and popularizing sustainability – the International Institute for Applied Systems Analysis (IIASA) and the World Commission on Environment and Development.

1. IIASA

The International Institute for Applied Systems Analysis (IIASA)[11] is a non-governmental research institution that brings together scientists from around the world to work on problems of common concern. IIASA instituted in 1982 a new international program, *Ecologically Sustainable Development of the Biosphere* (1986).

The most tangible result of the IIASA program to date is a 500-page volume of essays edited by William Clark and Robert Mann, entitled *Sustainable Development of the Biosphere* (1986). The introductory chapter of the book stated that, "A major challenge of the coming decades is to learn how long-term, large-scale interactions between environment and development can be better managed to increase the prospects for ecologically sustainable improvements in human well-being." (p. 5) This volume concentrates on the ecological approach and thus does not deal, as do the *Global Possible* and *Our Common Future,* with the social and political aspects of sustainability.

One of the most significant contributions of *Sustainable Development of the Biosphere* has been to emphasize the significance of the distinction between stability and resilience as goals. Sustainability, as C.S. Hollings first pointed out in 1973, can be defined in terms of stability or in terms of resilience. He later wrote these summary definitions (Clark, 1986):

> Stability is the propensity of a system to attain or retain an equilibrium condition of steady state or stable oscillation. Systems of high stability resist any departure from that condition and, if perturbed, returned rapidly to it with the least fluctuation. Resilience, on the other hand, is the ability of a system to maintain its structure and patterns of behavior in the face of disturbance.

Pursuing the same line of thought, Dahlberg (1987) has suggested the concept of "regenerative capacity" as preferable to the concept of stability.

While the distinctions may seem to be abstract, they have important practical meaning. Concentration on resilience implies less emphasis on trying to control systems by reducing their variability. It implies more emphasis on taking steps to profit from the natural capacity of systems to adapt by designing policies and institutions that can react constructively to inevitable but unpredictable surprises.

2. The World Commission on Environment and Development 1987

The World Commission on Environment and Development is an independent group established in 1983 by a resolution of the General Assembly which gave the Commission a broad charter to examine all aspects of the relationship between the environment and development. The Commission functioned as an independent body. The chairman (Mrs. Gro Harlem Brundtland, leader of the Norwegian Labor Party) was given the authority to name the other members of the Commission, to set the agenda, to select contributors and to write the report. They selected an impressive group of world political leaders and a staff of high quality. After a series of 17 open meetings, a draft report was written and circulated. The final report, *Our Common Future,* was released in 1987, and has become known as the Brundtland Report. Sustainability emerged as its central theme:

> Humanity has the ability to make development sustainable — to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits — not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth.
>
> Sustainable global development requires that those who are more affluent adopt life-styles within the planet's ecological means — in their use of energy, for example. Further, rapidly growing population can increase the pressure on resources and slow any rise in living standards; thus sustainable development can only be pursued if population size and growth are in harmony with the changing productive potential of the ecosystem. (*Our Common Future To One World. An Overview.* p. 8–9)

This manifesto is particularly interesting for several reasons. First, it transfers unconventional ideas generated in an academic, largely theoretical context to the national and international political arena. Second, it takes a broad rather than a narrow view of the meaning of sustainability. A third interesting aspect of *Our Common Future* is the energy and effectiveness of efforts to dramatize and popularize the recommendations of the report and to stimulate political action.

C. *The World Bank*

Through a series of steps relating to the effect of its activities on the environment, the World Bank has moved over a period of years toward building sustainability into its policies, administrative structure and operating modes. The term "sustainability" first existed in the lexicon of the bank in a narrow sense — the willingness of other entities to continue support for Bank-financed projects after the Bank loans have been disbursed. From 1981 to 1989, sustainability has been more broadly defined to encompass concern for the environment over the long run and for the effective management of renewable resources. Attainment of greater efficiency and equity are stated as goals separate from sustainability.

In 1981, the new President of the World Bank, A.W. Clausen, chose as the theme for his Fairfield Osborn Memorial Lecture, *Sustainable Development: The Global Imperative.* He developed the central idea that "Sustainable development and wise conservation are, in the end, mutually reinforcing and absolutely inseparable goods."

This and similar general policy declarations were followed by substantive changes, most notably in the reorganization of the Bank in 1987. "Despite the fact that some 500 staff positions have been eliminated in the reorganization, about 40 new environmental positions have been added." ("The Greening of the World Bank," *Science,* 17 June 1988, p. 1610.) In addition, a new Environment Department was created. In 1988, the Bank's Committee on Development, whose members are usually Minister of Finance, issued a report, *Environment and Development: Implementing the World Bank's New Policies,* that stated both a firm policy position stressing sustainable development as a central goal and stating the specific actions, current and contemplated, that the Bank has taken or will take to carry out the policy.

In the sphere of policy analysis as contrasted with operations, one of the most tangible Bank activities related to sustainability was a 1987 conference that produced a document entitled *Report of the World Bank Workshop on Sustainability Issues in Agriculture. Proceedings of the Seventh Agriculture Sector Symposium* (Ted J. Davis and Isabelle Schirmer, eds.). The papers presented at the Workshop were of high quality and contributed substantially to the evolution of concepts of sustainability. Particularly impressive papers were presented by W. David Hopper, *Sustainability, Policies, Natural Resources and Institutions,* and Robert Repetto, *Managing Natural Resources for Sustainability.*

D. *U.S. Aid* and *N.R.C.*

The U.S. Agency for International Development (AID) has moved with the Canadian and Nordic developmental assistance agencies towards recognition of sustainability as a central guiding policy. In 1987, the Bureau of Science and Technology of A.I.D. prepared a report, *Sustainable Agriculture,* that outlined current AID policy with respect to sustainability and posed a set of issues for analysis by the Board on Science and Technology for International Development (BOSTID) of the National Research Council (NRC). BOSTID convened a panel to address these issues. The panel defined sustainable farming systems in these terms:

1. It should maintain the long-run biological and ecological integrity of natural resources (soils, water, plants, animals, etc.) without which agricultural production cannot be increased, and possibly not sustained.

2. It should be viewed as an integral — and viable — part of a country's economic development strategy or process, taking into account cultural and socio-economic traditions. A system cannot be considered sustainable if farmers are unwilling or unable to adopt it.

3. It should provide ample economic returns to farmers, and farm-related industries to support essential investments in annual farm production activities, such as tillage, planting and ongoing resource conservation practices

(maintaining terraces and ditches).

4. It should contribute to the health and vitality of the rural cultures involved in the multiple aspects of food production.

E. *The Summit, 1989*

The legitimacy of concern over the consequences of environmental degradation and of the concept of sustainability was ratified at the highest political level by the communiqué issued at the conclusion of the meeting of the Group of Seven ("The Summit of the Arch") on July 16, 1989: "In order to achieve sustainable development, we shall ensure the compatibility of economic growth and development with the protection of the environment."

While this statement did not make specific proposals for national or international action, it did mark the escalation of an idea from a notion stated in a relatively obscure journal in 1972 to an idea with widespread appeal in 1989.

V. Conclusion

Before the broad concept of sustainability — meaning by that a definition encompassing a wide range of economic, political, and social goals — was forged, a more limited and rigorous approach to sustainability evolved under the intellectual leadership of a group composed primarily of biologists, ecologists, and environmental scientists. Well before the word "sustainability" was used, this group was conducting research in such areas as renewable resource management, the health of ecosystems and various conceptual and practical aspects of carrying capacity.

The emphasis of this group is on research related to physical concepts of sustainability. However, it may well be that values and choices based on ethical principles are an inevitable part of the concept of sustainability. To take one example, it is generally agreed that concern for the long run is a central part of all concepts of sustainability, including those that are rooted in physical concepts. Concern for the long run means concern for the welfare of future generations, and the weight to be given to the welfare of future generations is a matter of values.

The broad concept of sustainability is not likely to disappear. Those who prefer to define sustainability in value-free ecological terms first used the word only after those who incorporated systems of values in their definition of sustainability. Those who define sustainability in essentially ecological terms do not deny the importance of values in defining the goals of society. They simply maintain that both research and debate will be better defined and more productive if the questions of values are discussed so far as possible apart from sustainability. Those who prefer to incorporate a system of values in the definition of sustainability maintain that it is wrong and some say potentially disastrous to ignore those wider issues of values.

These views are rooted so deeply in contrasting philosophies that it seems unlikely that a single definition of sustainability will be universally accepted. This is not necessarily bad if those who use the term take pains to state explicitly what they mean by sustainability. In fact, it is probably more productive for analysts to

concentrate on precision and clarity in stating specifically what they mean by sustainability in the context of the specific problem with which they are dealing than to search for a generally acceptable single definition of sustainability.

Finally, criteria other than sustainability — notably productivity and equity — must be applied in judging the overall desirability of any system. High productivity is necessary if food is to be produced efficiently and, therefore, cheaply. But high productivity at the cost of sustainability sacrifices the future to the present. Sustainability is a worthy goal, but not a very useful one if the level of productivity is low. Accordingly, it is not helpful to single out sustainability, as has been done in some reports, as the one essential goal, or to use sustainability loosely as a general purpose code word encompassing all of the aspects of agricultural policy that the authors consider desirable. Finally, sustainability and productivity combined can not meet the ultimate goal of removing hunger unless food is distributed equitably.

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Notes

1. The sequence outlined below relies heavily upon Robert W. Kates and Ian Burton (eds.), *Geography, Resources, and Environment, Vol. II. Themes for the Work of Gilbert F. White.* (The University of Chicago Press, 1986.) The sequence is outlined in Chapter 13, "The Great Climacteric 1798 – 2048: The Transition to a Just and Sustainable Human Environment," p. 341.
2. The sequence of approaches and events sketched in this section is elaborated in Gilbert White, "Environment," *Science* 209, 4 July 1980.
3. White, *op. cit.*
4. For a full discussion of this topic, see Becky J. Brown et al. "Global Sustainability: Toward Definition," *Environmental Management.* Vol. II, No. 6, 1987, pp. 713–719.
5. The scientific validity of applying the concept of entropy to the earth has been challenged on the ground that the earth has an external source of energy — the sun.
6. In the same lecture, Ashby made this interesting point:

   > Is it morally defensible to use shock tactics, to exaggerate, to distort the facts or color them with emotive words, or to slant the television in order to excite the public conscience? My experience leads me reluctantly to believe that *in the present social climate* some dramatization is necessary. . . . Notice an important point about these enthusiasts: they are commonly what academics call unsound, which in academic circles is a highly perjorative epithet. . . . And yet, if these viewers had been coolly rational, if they had stuck meticulously to uncolored verifiable facts, would they have made any impression on the public conscience? I doubt it."

7. Quoted in the introduction to Dennis Meadows, *Alternatives to Growth.*
8. Susan Grimton Orr. *An Inquiry Into the Nature of Sustainable Societies: The Role of the Private Sector.* (Report of the 1982 Woodlands Conference. p. 11)

9. I have been as yet unable to trace the connection between the first use of the term in England in 1972 and in the United States between 1974 and 1977, and the subsequent first use of the word in a U.N. document in 1978. Nor have I been able to find whether, and if so how, the U.N. staff and consultants picked up the term from the British and American sources.
10. Some of the most prominent of these institutions were:
    1. The Dag Hammarskjold Foundation
    2. The International Union for the Conservation of Nature and Natural Resources
    3. The International Institute for Applied Systems Analysis
    4. The Scientific Committee on Problems of the Environment (SCOPE) of the International Council of Scientific Unions.
11. Situated in Laxenberg, Austria, IIASA was founded in October, 1972, by the academies of science and equivalent organization of twelve countries — Austria, Bulgaria, Canada, Czechoslovakia, Finland, France, German Democratic Republic, Federal Republic of Germany, Hungary, Italy, Japan, the Netherlands, Poland, Sweden, the U.S.S.R., and the U.S.A.

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