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The Evolution of Paradigms of Environmental Management in Development

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Abstract

The importance and the methodologies of environmental management in development are in a period of rapid change. For centuries, a usually implicit debate has prevailed between what have come to be called "economics" and "development" on one side, and the conservation of nature and "ecology" on the other, at least in Western civilization. In the past quarter century, as environmental management has become an increasingly explicit and significant matter requiring the attention of governments, this dichotomy has begun to break down. We are beginning to have serious discussions about "sustainable development." Many different ideas are emerging, from a wide range of disciplines, about what environmental management and sustainable development entail. Conceptions of what is economically and technologically practical, ecologically necessary, and politically feasible are rapidly changing. Five broad, fundamental paradigms of environmental management in development are described, referred to as "frontier economics," "deep ecology," "environmental protection," "resource management," and "eco-development." Each perceives different evidence, imperatives, and problems, and each prescribes different solutions, strategies, technologies, roles for economic sectors, culture, governments, and ethics, etc. Each paradigm actually encompasses many schools of thought, not always in complete agreement. There are overlaps between the paradigms; they have evolved from societies' basic assumptions about the relationship between man and nature, and are therefore related to each other. They are not completely distinct "species." The paper discusses the distinctions, connections, and implications of these five paradigms for the future of environmental management in development .

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THE EVOLUTION OF PARADIGMS OF ENVIRONMENTAL MANAGEMENT IN DEVELOPMENT

The Context

1. The subject of "environmental management"[1] and its integration with "development" is a major concern and challenge for a growing number of people, businesses, and governments of the world. While this is not a new subject, the level of concern and sense of urgency has reached new heights, and presently there is widespread discussion, a myriad of new proposals, commitments of resources, and programs of action. Some important indicators of this, from different realms, are:

- On the international political scene: the 1987 International Protocol on Ozone and its strengthening in 1989; the publication of the Brundtland Report, *Our Common Future*[2] and the responses of many governments and international agencies; the international agreement over the disposal of hazardous wastes; international meetings on global warming; the 1989 high level meetings in London, Amsterdam, and Geneva; and the furor over deforestation in the Amazon.

- Organizationally: the creation of a central Environment Department and four regional technical environmental divisions in the World Bank, and growing cooperation between the World Bank, environmental NGO's, and other international agencies to create and coordinate action agendas.

- In scientific circles, the general media, and the public: the widespread discussion of the emergence of severe global environmental threats such as destruction of the Ozone layer, the "Greenhouse Effect" of global warming, in addition to the persistence of droughts, mass-scale starvation, and tropical deforestation.

- Discussions in the Brundtland Report and the Spring 1989 journal issues of *Foreign Affairs* and *Foreign Policy* on redefining "national security" to incorporate the needs of environmental/resource quality and stability in addition to economic and military interests.[3]

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1 See Appendix for a list of Working Definitions for terms used in this paper.

2 World Commission on Environment and Development (WCED), 1987, *Our Common Future*, Oxford University Press, Oxford & New York.

3 Mathews, Jessica Tuchman, 1989. "Redefining Security", *Foreign Affairs, 68;* #2, 162-177.

2. With all this political, organizational, scientific, and public activity, the subject of how mankind is to integrate environmental management with concerns about economic and social development in order to create and ensure a future for civilization as it has come to be known is, sixteen years after the groundbreaking 1972 Stockholm UN Conference on the Human Environment, once again a major arena of debate. The practices of environmental management and economic development planning, and the paradigms that underlie them, are in a period of major revision.

3. At both operational and theoretical levels, there have been many developments since the Stockholm Conference which portend major changes in the way societies will think about the management of the relationship between nature and human activity in the future. Most of these advances have yet to be institutionalized into governments' and development agencies' policy and planning systems. In many respects, the Brundtland Commission said little that was not said at Stockholm, though perhaps it was said with more widespread participation and urgency. The ideas — that "sustainable development"[4] is necessary, that it requires careful management of the biophysical-geochemical resources and processes of the planet — are now in good currency once again, however. This brings with it both some threats and some major opportunities.

4. One concern is that the apparent consensus in public and political attitudes will not be met on a timely basis with more powerful tools, conceptual bases, and practical options to translate changing attitudes into real, large-scale changes in policies and actions. In other words, it is probably not yet a truly practical consensus. Without more powerful approaches, the concept of "sustainable development" may prove to be unsustainable (politically), subject to yet another period of disillusion and backlash.

Myers, Norman, 1989. "Environment and Security", *Foreign Policy*, #74, 23-41.

4 The concept of "Sustainable development" is showing some signs of unsustainability, due to the apparent difficulty of reaching agreement over its meaning, and the vagueness of even the better definitions that have been discussed. See Appendix.

A Taxonomy of the Evolution of Concepts of Environmental Management

5. All human activity, economic and socio-cultural, takes place in the context of certain types of relationships with the bio-physical world (in simpler words, relationships between people or societies, and the rest of nature). "Development" necessarily involves a transformation of these relationships. For instance, agriculture, of any sort, is a form of environmental management, but the types of agriculture implemented may reflect very different underlying conceptions of the relationship between nature and humans, and what "environmental management" means. As societies have evolved or developed, so has this relationship. Sometimes it evolved in ways that might be construed as mutually beneficial and ecologically sustainable. At other times or places, people exacted benefits by attempting to manage nature to improve their chances of survival and quality of life, in ways which have reduced local ecosystems' capacities to provide them in the future.

6. This was not too important when such activities took place on a scale that was minor compared to that of nature's own. When populations were small and new frontiers could always be found, people could move on to a new arena when they had exhausted the local capacity of the land to support their activities, and the land would then have time to regenerate itself (presumably). Between 1950 and 1986, however, the scale of the world population doubled (from 2.5 to 5.0 billion), while the scale of gross world product and world fossil fuel consumption each quadrupled.[5] *In this century, world population has tripled, and the world economy has expanded to 20 times its size in 1900.*[6] Matter and energy flows — the physical presence of the economy within the ecosphere — were not negligible in 1900, but they now rival in magnitude the flow rates of many natural cycles and fluxes. They are having major effects on the stability of the biogeochemical and physical processes that support life, human and otherwise, on this planet. Thus, the new political pseudo-consensus that societies can no longer operate as if economics and ecology were two separate disciplines, with no need to learn from each other. The new scholarly

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5 Daly, Herman, 1988, "Sustainability", mimeo.

6 Speth, James G., 1988. "The Greening of Technology", *Washington Post*, November 20, 1988, p. D4.

journal *Ecological Economics*, of the International Society for Ecological Economics, is another sign of the times.[7]

7. If one takes a slightly longer perspective on this "reborn" consensus, it is easy to see that it is more than just the second wind of a process that began in the 1960's. With a considerably longer view, and the idea of the evolution of the relationship between man and nature in mind, one can see that this relationship has taken on a very specific character, in the Western world, at least, since the time of the scientific revolution, and developed to its present state in that context. Going back even further in time, or by looking at other societies, one encounters other kinds of relationship between man and nature. Each society, in fact, has had its own relationship with nature. There even exist "ecological" accounts of history, with the thesis that the downfall of certain civilizations may have been more related to what today are called "environmental problems," than to the typical historical accountings of military give and take between societies.[8]

8. Peoples' views of their relationship with nature is one of the most important aspects of any strategy for human development. Since this relationship is at the root of each of the seemingly distinct fields of "environmental management," "economics," and "development," its evolution is of very basic importance to current discussions and the future practice of "sustainable development." Concepts of environmental management are now in a period of major flux, and underlying this, so are societies' fundamental ideas about the relationship between human activity and nature. The term "nature" is used here purposefully to represent one "side" of this relationship, rather than "environment," as the latter is itself a term that has evolved as a consequence of a particular worldview on the relationship between man and nature. In other words, it is the result of one of the very paradigms that are in flux, and as such is a particular conceptual representation of nature which is also [still] evolving.

9. The outcome of this evolutionary process is particularly important because, in the words of the Assistant Secretary of the Smithsonian Institution, Thomas Lovejoy, "most of the great environmental struggles will be won or lost in the 1990's. . . I am utterly convinced. . . that by the next century it will be too late."[9]

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7 International Society for Ecological Economics, 1989. *Ecological Economics*. Elsevier Science Publishers, Amsterdam. Several World Bank staff are involved in the founding and editing of this journal.

8 Cronon, William, 1983. *Changes In the Land: Indians, Colonists, and the Ecology of New England*. Hill and Wang, New York, is one of the finest examples. Recent studies of the Roman and Mayan civilizations have also provoked thought in this vein.

9 Lovejoy, Thomas, August, 1988. Remarks in an address to the American Institute of Biological Sciences. quoted in Wicker, Tom, 2-28-89, "Decade of Decision", *New York Times*, Op-Ed column.

10. There are many ways of describing this fundamental relationship and how different social conceptions of it translate to or impact on practical management. It is proposed here that there are five basic paradigms of management of the relationship between humans and nature, or of "environmental management in development." Each paradigm is driven by different assumptions about human nature and activity, about nature itself, and the interactions between nature and humans. Each asks different questions and perceives different evidence, dominant threats or risks (problems for development), and solutions and management strategies. They also have different flaws, of course. Many of these differences will be highlighted for purposes of distinction. However, it is important to emphasize that these paradigms are not completely distinct or unrelated. Because some aspects are shared between two or more of the paradigms presented, the reader may feel that some of the distinctions made are overdrawn. In part this is true, in part it is evidence of the transitional stage of the debate about just what sustainable development and environmental management entail. All too often, the implications of changing conditions and innovations in thought in the field have not been explored; all variations are viewed by the dominant paradigm as belonging in a single basket of strange thoughts. This is why "environmentalism" (an awful word) or environmental management can look so confusing to "non-environmentalists" — but it is nowhere near as monolithic as the latter tend to believe; just as economics is nowhere near as monolithic as many assume. This is what makes the debate about just what "sustainable development" means so interesting — and what makes greater clarity so very important.

11. Certain approaches *are* more appropriate to different problems or issues than others, and all will be necessary for long into the future; what is definitely changing is the dominance or relative degrees of emphasis the different approaches are given. At least in part due to shortcomings in the previously dominant approaches, some of the paradigms have evolved out of the others, retaining many of their predecessors' features within an expanded framework, or expanded boundaries of the system considered. It should also be noted, of course, that there are still disagreements and *many* schools of thought within each general paradigm presented. This paper will identify the core differences between the paradigms and begin to explore their implications.

12. The following titles are proposed and used for the five paradigms:

- **"Frontier Economics"**
- **"Deep Ecology"**
- **"Environmental Protection"**
- **"Resource Management"**
- **"Eco-Development"**

13. Table 1 is a summary of the distinctions between them, along the dimensions mentioned above. However, a one-dimensional (horizontal) array of the five paradigms can be misleading about the "evolutionary" relationships between them. For this reason, a two dimensional diagram (Figure 1) is provided which attempts to convey this information more clearly, though still inadequately. The relationships and significance of them is what needs to be thought out by societies. It is also worth noting that within the basic dimension of dominant perceived threats, one could construct a sub-list of particular problems or risks and then a whole additional matrix of the "solutions" preferred by each of the paradigms. Following the table is a more detailed discussion of each paradigm and the concepts raised in the table.

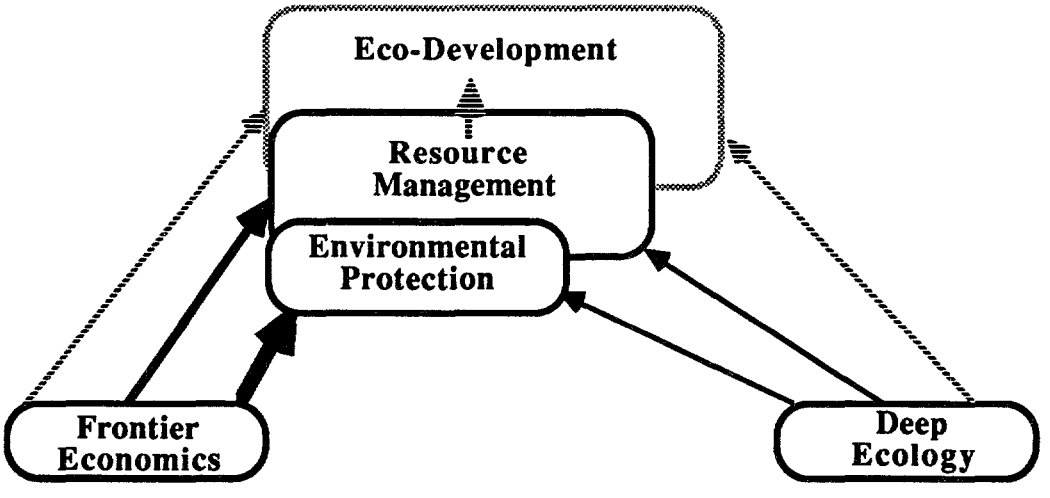

FIGURE 1. Evolutionary Paradigms Diagram.

The diagram attempts to indicate schematically the non-linearity of paradigm evolution in the following ways: the progression in time from one paradigm to the next going upward, with the horizontal scale indicating the upper three paradigms' position on a spectrum between the "diametrically opposed" frontier economics and deep ecology paradigms. The size of the boxes signifies (roughly) the degree of inclusiveness and integration of social, ecological and economic systems in the definition of development and organization of human societies. Non-solid lines indicate the hypothesized future.

Table 1. Basic Distinctions Between Five Paradigms of Environmental Management in Development

Paradigm > Dimension	*Frontier Economics*	*Environmental Protection*	*Resource Management*	*Eco-Development*	*Deep Ecology*
Dominant Imperative:	"Progress," as Infinite Economic Growth and Prosperity	"Tradeoffs," as in Ecology versus Economic Growth	"Sustainability" as necessary constraint for growth/development.	"Green Growth": Co-developing Humans and Nature; Redefine "Security"	"Eco-topia": Anti-Growth "Constrained Harmony with Nature"
Human-Nature Relationship:	Very Strong Anthropocentric	Strong Anthropocentric	Modified Anthropocentric	Ecocentric	Biocentric
Dominant Perceived Threats:	Hunger, Poverty, Disease, "Natural Disasters"	Health Impacts of Pollution, Endangered Species,	Resource Degradation; Poverty, Population growth	Ecological Uncertainty Global Change	Ecosystem Collapse "Unnatural" Disasters
Main Themes:	Open Access/Free Goods Exploitation of Infinite Natural Resources	Remedial/Defensive "Legalize Ecology," as Economic Externality	Global Efficiency "Economize Ecology" Interdependence	Generative Restructuring "Ecologize Economy" Sophisticated Symbiosis	Back to Nature "Biospecies Equality" Simple Symbiosis
Prevalent Property Regimes:	Privatization (Neoclass.) or Nationalization (Marx.) of all property	Privatization Dominant; Some Public Parks set aside	Global Commons Law for Conservation of: Oceans, Atmosphere, Climate, Biodiversity?	Recontextualize Private & Common Property regimes for Intra/Inter- Generational Equity & Stewardship	Private, plus Common Property set aside for Preservation
Who Pays?	Property Owners (Public at Large: esp. Poor)	Taxpayers (Public at Large)	"Polluter Pays" for Right (Poor bear impacts)	"Pollution Prevention Pays" Integrated Ecodevelopment	Avoid costs by foregoing development
Responsibility for Development and Management:	Property Owners: Individuals or State	Fragmentation: Development decentralized Management centralized	Toward Integration across multiple levels of gov't. (e.g., fed./state/local)	Private/Public Institutional Innovations & Redefinition of Roles	Largely Decentralized but integrated design & mgmt.
Environmental Management Technologies and Strategies:	Industrial Agriculture: High Inputs of Energy, Biocide, & Water; Monocultures, Mechanized Production Fossil Energy Pollution Dispersal Unregulated Waste Disposal High Population Growth "Free Markets"	"End-of-the-Pipe" or "Business as Usual Plus a Treatment Plant" Clean-up. "Command and Control" Market Regulation: Some Prohibition or Limits, Repair, & Set-asides. Focus on Protection of Human Health, "Land Doctoring" Envir. Impact Statements	Impact Assessment & Risk Management, Pollution Reduction, Energy Efficiency, Renewable Resource/ Conservation Strategies, Restoration Ecology, Population Stabilization & Technology-Enhanced Carrying Capacity, Some Structural Adjustment	Uncertainty (Resilience) Management, Eco-Technologies, e.g: Renewable Energy, Waste/Resource Cycling for Throughput Scale Reduction, Agro-forestry, Low Input Agriculture, Extractive Forest Reserves Population Stabilization & Enhanced Capacity as RM	Stability Management Reduced Scale of Mkt Economy (inc. Trade) Low Technology Simple Material Needs Non-dominating Science Indigenous Tech. Systems "Intrinsic Values" Population Reduction
Analytic/ Modeling and Planning Methodologies:	Neoclassical OR Marxist Closed Economic Systems: Reversible Equilibria, Production Limited by Man-made Factors, Natural Factors not accounted for. Net Present Value Maximization Cost-Benefit Analysis of tangible goods & services	Neoclassical Plus: Environmental Impact Assessment after Design; Optimum Pollution Levels Equation of Willingness to Pay & Compensation Principles	Biophysical-Economic Open Systems Dynamics: Include Natural Capital. True (Hicksian) Income Maximization in SNAs Increased, Freer Trade Ecosystem & Social Health Monitoring; Linkages between Population, Poverty, & Environment	Socio-Technical/ Ecosystem Process Planning & Design Integration of Social, Economic, & Ecological Criteria for Technology Participation & Autonomy Indigenous Goals & Management; Land Tenure & Income Distrib. (Equity) Geophysiology	Grassroots Bioregional Planning Multiple Cultural Systems Conservation of Cultural & Biological Diversity Autonomy
Fundamental Flaws:	Creative but Mechanistic; No awareness of reliance on ecological balance	Defined by F.E. in reaction to D.E.; Lacks vision of abundance without scarcity	Still anthropocentric, Subtly mechanistic; Doesn't handle uncertainty	Magnitude of changes require new consciousness Doesn't manipulate fears	Defined in reaction to F.E.; Organic but not Creative; How reduce population?

M.E. Colby: Matrix 1- 9/6/89 (Frontier Economics) (Environmental Protection) (Resource Management) (Eco-Development) (Deep Ecology)

Frontier Economics

14. "Frontier economics" is the term used by economist and systems theorist Kenneth Boulding to describe the approach that prevailed in industrial countries (from at least the time of the scientific revolution) until the late 1960's. At its most basic, it treats nature as an infinite supply of physical resources (raw materials, energy, water, soil, and, air) to be used for human benefit, and as an infinite sink for the by-products of the development and consumption of these benefits, in the form of various types of pollution and ecological degradation.[10] This *throughput aspect of the flow of resources from nature into the economy and the flow of wastes back out into the "environment"* did not enter into predominant economic thinking, because it was believed to be *infinite* in potential, while neoclassical economics was chiefly concerned with the allocation of those resources perceived to be *scarce*.[11] Thus, according to this view, there is no explicit biophysical "environment" to be managed, because it is irrelevant to the economy. According to Lester Thurow (in 1980), "worries about natural resource exhaustion are hard to rationalize from the point of view of economics."[12]

15. Hence, the economy became disembodied from nature, in theory and in human practice. *"The standard textbook representation of the economic process by a circular diagram, a pendulum movement between production and consumption within a completely closed system,"* with all flows being completely reversible, (Figure 2) was widely accepted.[13] This posed little problem as long as the rate of demand for natural resources and ecosystem services did not exceed nature's capacity to provide them. Since this capacity was assumed to be infinite, for all practical purposes, the issue of *scale* of total resource flow relative to total resource stocks was not considered.[14] The primary limiting factors of production are perceived, in both neoclassical and Marxist economic analysis, to be human labor and man-made capital. There is an unbridled faith in the "progress" of human ingenuity, in the benevolence of technological advancement, and their capacity to reckon with any problems that might arise (i.e., through substitution when scarcity causes prices to rise). Since both nature's capacity and human ingenuity are seen as boundless, there is little conceptual possibility for the combination of the accumulation of damage and the depletion of resources to

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10 Boulding, Kenneth, 1966. "The Economics of the Coming Spaceship Earth," in H.E. Jarrett, ed., *Environment al Quality in a Growing Economy*, Johns Hopkins Press, Baltimore.

11 Daly, Herman E., 1989. "Steady-State Versus Growth Economics: Issues for the Next Century." Paper for the Hoover Institution Conference on Population, Resources and Environment, Stanford University, February 1-3, 1989.

12 Thurow, Lester, 1980. *The Zero-Sum Society*. Basic Books, New York, p. 112.

13 Georgescu-Roegen, Nicholas, 1971. *The Entropy Law and the Economic Process*, Harvard University Press, Cambridge, MA.

14 Daly, Herman E., 1989. Op. cit.

eventually limit production and human opportunity. Sometimes economic theory blocks out ecological reality, not to mention its impact on economic reality — but sometimes it is economists, not their theory, who narrow their "practical" concerns within a theoretical framework which might be sufficient to handle many ecological problems if properly applied. It is a paradox of economics that "value" is generated by creating scarcity; depleting and degrading resources increases their measured value, but it usually hurts people, the economy, and the functionality of the ecosystem on which they rest.

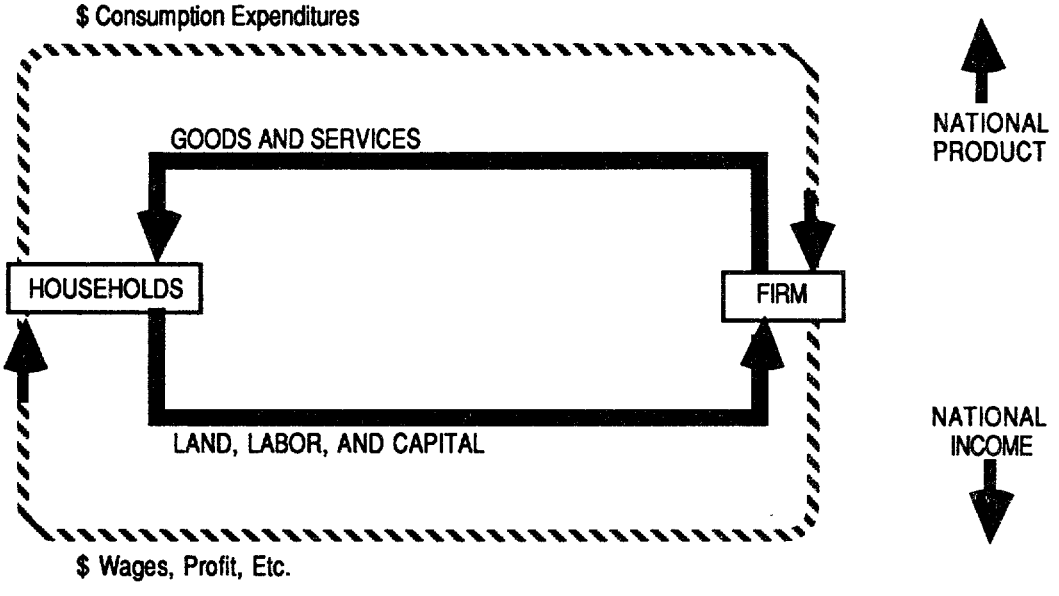

FIGURE 2. Neoclassical Circular Flow Model of Economic Production.
Households sell or rent land, natural resources, labor, and capital to firms in return for rent, wages, and profit (factor payments). Firms combine the factors of production to produce goods and services in return for consumption expenditures, investment, government expenditures, and net exports.[15]

16. Consistent with widespread interpretations of the major Western religions and Francis Bacon's "Technological Program" for the development of modern Western science, nature is seen in this paradigm as existing for man's instrumental benefit, to be explored, manipulated, exploited, modified, and even "cheated" in any way possible that could improve the material quality of human

15 Modified from Hall, Charles A.S, Cutler J. Cleveland, & Robert Kaufmann, 1986. *Energy and Resource Quality: The Ecology of the Economic Process.* Wiley-Interscience, New York; and Heilbroner, R.L., and L.C. Thurow, 1981. *The Economic Problem.* Prentice-Hall, Englewood Cliffs, NJ.

life.[16] In fact, nature was to be remade according to man's image, transformed so as to be more suitable to humans' needs and desires. The relationship between human activity and nature under this management paradigm thus can be seen as *unilaterally oriented (anthropocentric)*. From "nature's perspective," the relationship may have been characterizable as *zero-sum*, or *negative* ; humans benefitted at the expense of other species and natural ecosystems.

17. This type of relationship between society and nature is common to relatively decentralized, capitalist economies and to centrally-planned, Marxist economies. They differ in tactics, such as in the type of property regime promoted as most efficient and/or desirable (private property versus state property), responsibility for governance and design of activity, and in how the income from production is to be distributed, but the underlying worldviews about the roles of people and nature, and their ultimate goals, are much the same. Their visions are of infinite economic growth and human "progress."

18. Many technologies that have been used for "development" could thus be seen, with a minor adjustment in view, as technologies or strategies for managing the environment, since they were developed for the purpose of increasing man's power to extract resources and production from nature, and/or to reduce the negative impacts of nature's variability on society. A prime example is modern, industrial agriculture, which in order to solve the basic problem of hunger, replaced natural nutrient cycles and pest control with man-made chemicals, irrigation, and fossil fuel energy. Another example is the "tall smokestacks" strategy of waste dispersal, based on the idea that if pollution is spread thinly enough, it will go unnoticed, by people or by nature.

19. Most developing nations have emulated this basic approach to economic and environmental management in one way or another. They have been in no small way encouraged by not just the example and teachings, but also the direct policies prescribed for them by the leaders and policy-makers of industrialized nations and international development and financial institutions.[17] This approach was sometimes justified as a minor evil, "necessary" during the pre- and early-industrial stages of development, as was rapid population growth, in order to achieve a more advanced state. This population growth then became a reason for yet more resource consumption and pollution. It is believed that damage can easily be repaired, where necessary, after development has proceeded

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16 Berman, Morris, 1981. *The Reenchantment of the World,* Cornell University Press, Ithaca, NY, pp. 14-18.

17 It should be noted that such prescriptions were not necessary intentionally harmful; they arose due to the implicit, often unconscious assumptions made about the relationship and interdependence between human activity and nature. Unfortunately, the hidden effects were built into the policies. Many of these institutions and leaders are now trying to change this.

to some point where explicit environmental management can be afforded (see "Environmental Protection"). The vision is one where infinite technological progress and economic growth would eventually provide affordable ways to mitigate environmental problems (and others, such as equity). The fundamental flaw is a lack of awareness of the human reliance on ecological balance.

20. One major problem with this philosophy arises from an important difference in vulnerability to ecological degradation between temperate (industrial country) and tropical (developing country) environments, and the types of "environmental" problems they face; the resource depletion and ecological destruction going on in tropical nations is in many cases irreversible on a human time scale, unlike the pollution problems which dominated environmental concerns in the industrial countries (at least until very recently; the ozone and global warming issues may be irreversible). In the late 1980's, most developing nations have come to see that they are damaging their own future prospects by pursuing development strategies and policies that are unsustainable, though they often feel that they have no choice. Natural resources and ecological processes are now becoming "scarcer," and so economic theory must change to incorporate them. A vicious circle of poverty and ecological destruction has been set up, often as a direct result of "development," with a unifying theme of increasing marginalization of people and the land on which they live.

Deep Ecology

21. "Deep ecology" is one name for a worldview that has been widely interpreted as the polar opposite of frontier economics (by advocates of both perspectives). In many regards, it is a reaction to many of the consequences of the dominant paradigm. It is much less widely understood or accepted, though as a political movement it is growing. *Deep* ecology is not to be confused with the *science* of ecology (see Appendix). In its current form, it is an attempt to synthesize many old and some new philosophical attitudes about the relationship between nature and human socioeconomic activity, with particular emphasis on ethical, social, and spiritual aspects that have been downplayed in the dominant economic worldview. Deep ecology is far from a unified, consistent philosophy as of this date.[18] This title actually comes from one school

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18 Though it has been criticized for a lack of coherence, even from within the Green Politics fold, some Deep Ecology advocates consider this to be a strength rather than a weakness, promoting diversity and flexibility. At any rate, neither is economic theory anywhere near as unified and consistent as its advocates or its critics are wont to assume. For some interesting discussions of the differences between various "ecological" philosophies, see Vol. 18, No. 4/5 (1988) of the British journal, *The Ecologist*.

of thought within the philosophical spectrum of "Green Politics," the latter of which draws eclectically on various schools such as the modern science of systems ecology; wilderness preservationism; 19th century romanticism and transcendentalism, eastern philosophies such as Taoism; various religions' concepts of ethics, justice, and equity; ecofeminism; pacifism; Jeffersonian decentralized, participatory democracy; and some of the social equality aspects of socialism (which some have termed "social ecology").

22. Deep ecologists promote merging an understanding and appreciation of some of the more technical, scientific aspects of systems ecology with a non-anthropocentric ("biocentric," or "harmonious") view of the relationship between man and nature, which often means putting man under nature, the reverse of the frontier economics hierarchy. Among the basic tenets are intrinsic "biospecies equality" (the Convention on the International Trade of Endangered Species, or CITES, signed by over one hundred nations, is a step toward the achievement of this goal); major reductions in human population (effective *and* egalitarian means of achieving this are never specified); bioregional autonomy (reduction of economic, technological, and cultural dependencies and exchanges to within integrous regions of common ecological characteristics); promotion of biological and cultural diversity; decentralized planning utilizing multiple value systems; non-growth oriented economies; non-dominant (simple or low) technology; and more use of indigenous management and technological systems. Deep ecologists (as well as many systems analysts of the resource management and eco-development paradigms) see technological fixes as usually leading to larger, more costly, more intractable problems — not exactly a desirable form of "progress."

23. The application of this philosophy would result in radical changes in social, legal and economic systems, and definitions of "development." Its advocates promote major changes in the quality and extent of human modification of nature, to symbiosis with nature. While *some* of these principles can actually be of great use in future development planning approaches, the extreme — to expect the whole world to return to pre-industrial, rural lifestyles and standards of living —has been widely regarded as highly impractical. Even if everyone wanted to, this would be impossible at current population levels and rural land degradation. The extreme imperative is of an anti-growth "Eco-topia," of a constrained "harmony with nature." While this may be organic, it tends not to be creative — one of the fundamental drives in the evolution of both nature and human society. The following table comparing this worldview directly with Frontier Economics is modified from the book *Deep Ecology: Living as if Nature Mattered.*[19]

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19 Devall, Bill, and George Sessions, 1985. *Deep Ecology: Living as if Nature Mattered.* Peregrine Smith Books, Salt Lake City, p. 69.

TABLE 2.

Dominant Economic Worldview	vs.	Deep Ecology Worldview
Dominance over Nature		Harmony with nature; symbiosis
Natural environment is a resource for humans		All nature has intrinsic worth; biospecies equality
Material/economic growth for growing human population		Simple material needs, serving a larger goal of self-realization
Belief in ample resource reserves		Earth "supplies" limited
High technological progress and solutions		Appropriate technology; non-dominating science
Consumerism, Growth in consumption		Do with enough; recycling
National/centralized community		Minority traditions/ bioregions

Environmental Protection

24. The dominance of the frontier economics paradigm began to weaken in the 1960's, especially after the 1962 publication of Rachel Carson's book, *Silent Spring*. By the end of that decade, pollution was a major concern in the industrialized nations. Scientists began to study "environmental problems," usually related to pollution or the destruction of habitats and/or species. The recognition of the pollution problem in the polarized context of frontier economics versus the nascent deep ecology schools led to the perception of the necessity to make compromises, or tradeoffs; the constrained perception of "Ecology *versus* Economic Growth" became freshly explicit.

25. "Environmental impact statements" were institutionalized in some industrial countries as a rational means to assist in weighing the costs and benefits of development activities before they began. In actuality, statements often were added on after project planning and design were well along, so that the late-coming environmental concerns usually ended up being perceived as "anti-development." Even at its best, the process tends to focus on comparing a few alternative actions to find the least damaging one, rather than setting some "minimum standards" and then seeking an option that meets them. This is the beginning of what might be called the takeover of the "negative, or defensive agenda" in practical environmental management policies and actions, though the assumptions and values implicitly underlying it go much further back in time. It is still fundamentally anthropocentric, though modified in the case of some major endangered species and

set-aside wilderness areas (a case can be made for the latter still being basically to satisfy human aesthetic values).

26. By "negative," it is not meant that the environmental protection approach explicitly set out to harm the environment. On the contrary, environmental protection and therefore, management, was now at last an explicit enterprise, contrary to most of Western history, and this was certainly a "positive" development. It is termed negative because it institutionalized an approach that focussed on repairing and setting limits to harmful activity. Rather than focussing on ways to *improve* both development actions and ecological resilience, this approach was concerned mainly with *ameliorating* the effects of human activities. In its essence, the approach is inherently defensive or *remedial* in practice. It has also been described as the "end-of-the-pipe" or "business-as-usual, plus a treatment plant" approach. To use a medical analogy, "land doctoring" is practiced rather than "land health." Economic analysis is still based on the neoclassical model of the closed economic system.

27. When regulatory approaches were created to set limits, they usually focussed on activities that resulted in "excess" pollution. Excess or "optimal pollution levels" were defined more by short-term economic acceptability (and therefore, politics) than by what was necessary for the maintenance of ecosystem resilience (admittedly, in part due to the fact that ecologically appropriate levels were/are not known). The limits enacted were thus often arbitrary from a scientific-ecological point of view. Pollution dispersal continued to be a common approach to amelioration, even when it created yet larger, more costly problems down the road, such as international transport of acid precipitation. In keeping with the dominant paradigm of separation of issues and fragmentation of responsibility in government, separate "Environmental Protection Agencies" were created. They were responsible for setting the limits, and in some cases, cleaning up after limits were exceeded, but they were not responsible for planning development activities in ways that did not pollute or impair necessary ecological functions, or better still, that facilitate ecological functions at the same time as taking advantage of them. As many pollution problems grew, the after-the-fact, clean-up nature of this type of management grew (e.g., the clean-up of the North American Great Lakes and the United States' Superfund), as did the prescription of new technological solutions to mitigate pollution problems (e.g., very expensive smokestack "scrubbers").

28. In this approach, relatively small parcels of common property sometimes were converted to state property to be set aside for preservation or conservation as national parks and wilderness reserves. A more pervasive conceptual tenet of this path, however, is the neoclassical belief in the

privatization of property as a principal solution to overuse of resources. Garrett Hardin's classic allegory of "The Tragedy of the Commons" has been widely accepted by researchers and development practitioners as a basis for this prescription.[20] Common property regimes are associated with "inevitable" resource degradation. This has become the dominant paradigm within which social scientists assess natural resource issues. Unfortunately, "the Hardin metaphor is not only socially and culturally naive, it is historically false."[21] What were actually *open access* property regimes with the stereotypical "tragic" consequences, were lumped together with *common* property regimes (under which specific usage rights and duties apply to a finite group, and from which others are excludable), which can be and often are actually sustainable (if the usage rights and duties are ecologically sound and enforceable).

29. The Stockholm UN Conference on the Human Environment in 1972 signaled the internationalization of the problem of environmental disruption, and therefore, the subject of explicit management. While it is quite unfair to say that the conceptual framework of the organizers of Stockholm and its follow-up (such as the creation of UNEP, the Cocoyoc Conference in 1974, etc.) was exclusively of the "remedial" focus described above, the predominant practical consequences were still in this mode. UNEP has no operational power and no responsibility for truly changing the ways in which development activity is organized and measured. It is an information-gathering agency, ensconsed in Nairobi, far from the corridors of power, financial resources, and decision making. Most developing countries have been slow to implement comprehensive and effective protective legislation, planning and enforcement, partly because they believed they could not afford it (in the neoclassical sense, excluding the externalities) and partly because it is perceived as unfairly restricting their development potential. Governments often have seen environmental concerns, especially pollution and land/wildlife protection, as the interests of the elite class or rich countries, and contrary to their needs and interests; more constraining than helpful. Somewhat paradoxically, governments do usually bow to those same rich, elite interest groups when they resist land reform measures that might be useful in addressing some of the problems. Another paradox is that the poor are harmed more by both pollution and resource degradation than are the rich.

30. This perception of unaffordability and unfairness is at least in part due to the fact that the environmental protection approach is basically a modest variation on the "frontier economics"

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20 Hardin, Garrett, 1968. "The tragedy of the commons." *Science, 162;* 1243-8.

21 Bromley, Daniel W. and Michael M. Cernea, 1989. "The Management of common property natural resources: some conceptual and operational fallacies." Paper at the World Bank Ninth Agricultural Symposium, January 10-11, 1989, Washington, DC.

paradigm of development, and even that was at least in part thrust on developing countries by industrial nations. Because of the types of information sought in economic analysis, this variation only shows up as added costs. Development activities that are also ecologically beneficial (or even benign) are rarely recognized as such. Impacts of excessive environmental depletions (resource exploitation) or insertions (pollution) are considered to be "externalities" to the economy. Therefore they are dealt with after they occur, for the most part, and usually paid for by the public at large, in the forms of quality of life degradation and/or increased taxes. The ecosystem in general is seen as external to the economy. The impacts of pollution on human health and the aesthetic quality of the environment are often the prime "environmental" concerns of industrial country governments; for this reason, some economists have claimed that it is mainly the concern of the industrial middle class.[22] Resource depletion and ecosystem services are still not perceived in policy-making circles as serious limiting factors, because of an unbridled faith in technological progress and substitution. The very use of the term "environmental" as a label for these types of problems belies how small the change in attitudes which underlie the approach really are. Under a different set of assumptions about the relationship between man and nature, they might be more properly called "economic," "resource," or perhaps most appropriately, "development" problems.

31. The interaction between human activity and nature can still be seen as negative from nature's perspective (hence the dichotomous perception of "environment versus development"). The basic purpose of this interaction is still unilateral or anthropocentric. Setting aside national parks and cleaning up of pollution are still done primarily for human benefit, whether health- or aesthetically-oriented. Future rationales for parks or reserves may focus more on their genetic *resource* and climate regulation values, but again, these resources are intended for potential use by humans. That is what the term "resource" implies. It may seem unusual now, but we may not be far from considering "climate" and other natural processes as among the most vital of resources. Economists still focus almost exclusively on the market economy. Little understanding of "nature's economy" (the ecology of resource processes: the stocks and flows of nutrient cycles, ecosystem services, throughput processing abilities of different ecosystems, the interdependence of

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22 This perception is reinforced in industrial nations because it is the middle class that is most vocal and powerful politically, and the marginality of costs affects it the most. The survival priorities of the poor supersede their environmental quality interests. In terms of actual health effects, the impacts are probably most severe on the poor, however. The story in developing countries is quite different because resource depletion is often felt more severely than pollution effects, and it is the poor who are most affected. Hence, in some developing countries such as India, "ecology movements" have risen from the lower classes. This is one of the more important distinctions between "environmental" problems of the industrial versus developing nations, and a major impetus for the shift to the next paradigm, "Resource Management." See--

Bandyopadhyay, Jayanta and Vandana Shiva, 1988. "Political economy of ecology movements", *Economic and Political Weekly*, June 11, 1988, pp 1223-1232.

ecosystems and climate, etc.)[23] or the "survival economy" (that part of human activity which does not enter into any market statistics but nonetheless supports hundreds of millions of people's lives) enters into economic analysis or development planning.

Resource Management

32. The immediately preceding paragraphs provided ample foreshadowing that "Resource Management" is the emerging approach. It is the basic theme of reports such as the Brundtland Commission's *Our Common Future*, the Worldwatch Institute's annual *State of the World* , and the World Resources Institute's annual *World Resources* reports. It is both a substantial change from and a fairly natural extension of the economic paradigm (therefore, it can be termed "evolutionary," rather than "revolutionary"), to include all types of capital and resources — biophysical, human, infrastructural, and monetary — in calculations of national accounts, productivity, and development planning. It directly contradicts the frontier economics assertion that natural resource exhaustion is not a matter of concern. Pollution can even be considered a "negative resource," rather than as an externality. As mentioned, climate may become regarded as a resource to be managed under this paradigm. The interdependence and multiple values of various resources are taken into greater account (e.g., the role of forests in watershed and climate regulation, affecting hydropower, agriculture, and fisheries productivity).

33. The beginnings of the relatively "neutral" (this to be explained below) resource management paradigm lie in an extension of economics' concern with resource allocation. Global systems dynamics modelers began to model not just the resources of capital and labor, but also the interactive supply and demand of other "natural resources," including energy, valuable metals, fisheries, forests, soils, and water, which were perceived as becoming scarcer, and the existence of "negative" resources such as pollution. The publication of the Club of Rome's *The Limits to Growth* in 1972 was a landmark in this regard. This report, along with subsequent modelling attempts such as the U.S. *Global 2000 Report to the President* in 1980, was widely vilified because it projected a future of "doom and gloom" based on linear extrapolation of trends without considering the positive potential of technological change, resource substitution, and price

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23 Worster, Donald, 1977. *Nature's Economy: A History of Ecological Ideas.* Univ. of Cambridge Press, Cambridge, U.K. and
Perrings, Charles, 1987. *Economy and Environment: A Theoretical Essay on the Interdependence of Economic and Environmental Systems*, Cambridge University Press.

mechanisms. These "systems analysis" arguments then languished in policy-making circles in the early 1980's, amid a resurgent political climate of economic and technological optimism, and faith in free markets and trade growth. Also playing a major role were the debt crises in developing countries which were so acute that usually, rather than implementing even the defensive or remedial approach described above, they sometimes led to increased rates of extraction and destruction of natural resources, in an attempt to pay off their debt and meet the immediate needs of rapidly growing populations.

34. Outside of major policy and decision-making circles, however, much work continued along the lines of the systems analytical framework. Methodologies, monitoring, and documentation improved, particularly with regard to resource depletion, population pressure, and the circular links with poverty. Interdisciplinary fields such as ecology, living systems, and self-organizing systems developed more rigorous systems modeling methods. Many of the threats predicted in earlier modeling efforts have in fact come true, despite the fact the one often reads statements that the doom and gloom scenarios have been "vanquished." "Global Commons" resources, such as the atmosphere in general and the ozone layer in particular, climate variation, biodiversity, and oceanic resources, have emerged as issues for which current legal, economic, political, and institutional structures and concepts are seriously deficient. No environmental management program in developing countries can successfully achieve sustainability without stabilization of population levels.

35. Non-governmental and international organizations, such as the International Union for the Conservation of Nature and Natural Resources (IUCN) and the UN, prepared the World Conservation Strategy and the World Charter for Nature. Many more conferences were held. Collaborative efforts such as the Tropical Forestry Action Plan were launched.[24] It was argued that increasing efficiency of resource use, through conservation, wise management, and policies that integrated economic and ecological principles, along with ever-relied-upon promises of technological advances, would prevent disaster and ensure that *"The Global Possible"*[25] would be achieved.

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24 By the World Bank, UNEP, UNDP, FAO, and the World Resources Institute.

25 Repetto, Robert (ed.), 1986, *The Global Possible: Resources, Development, and the New Century*, World Resources Institute, Washington, D.C.

36. New initiatives in global commons law have already taken hold, with several more possible.[26] The combination of greater resource depletion, pollution, continued population growth, rising energy costs, climatic changes, land destruction, and high debt burdens have created economic and social conditions in developing countries that are much worse than they were ten, or in parts of Africa, even twenty years ago. These conditions seriously threaten possibilities for economic growth and prosperity, not to mention survival, for large numbers of people. "Risk management" is now a major aspect of management of the interactions between economic activity and its human and ecosystem health consequences, and a subject of numerous international conferences.[27]

37. The resource management approach might be termed as "*neutral*" because its greater emphasis on long-term sustainability of resource use and development activity in general is based on an attitudinal shift toward appreciation of the interdependence of human activity and ecosphere resilience. Concern for the environment no longer implies that one is anti-development; in fact, sustainable development depends on it. It is understood that the scale of human activity is so large that it now affects nature as much as nature affects man, and these impacts feed back on the quantity and quality of human life that is achievable. The neoclassical imperative of economic growth is still the primary goal of development planning, but criteria of sustainability are viewed *as necessary constraints* .[28]

38. Much work is being done to integrate understanding of the economy of nature with the economy of markets, and to improve the System of National Accounts (SNAs) accordingly (the subject of several Working Papers by the World Bank's Environment Department and work of the World Resources Institute and UNEP). Despite the fact that *ecology* and *economics* come from the same Greek root, (*oikos*, meaning "house") the sciences of ecology and economics have very different concepts of what *production, capital, health, resource,* etc. mean. Calculations of *Hicksian income*, which is by definition sustainable, need to incorporate natural, or non-man-made capital as well as man-made economic resources such as labor, money, infrastructure. Perhaps

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26 Previous efforts included: The Antarctica Treaty, the Convention on the International Trade of Endangered Species (CITES), the stalled Law of the Sea, the Nile Waters Agreement, and the U.S.-Canada Boundary Waters Treaty. Contemporary measures include the 1988 Montreal Protocol on Ozone and subsequent efforts to strengthen it, International Trade of Hazardous Wastes, a renegotiated Antarctica Treaty. Other possibilities include an "International Law of the Atmosphere", a "Biodiversity Conservation Agreement", recognition of World Court jurisdiction by the nations of the UN Security Council, etc.

27 Kleindorfer, Paul K. and Howard C. Kunreuther, eds., 1986. *Insuring and Managing Hazardous Risks: From Seveso to Bhopal and Beyond.* IIASA and Springer-Verlag, Berlin/New York. The World Bank hosted its own conference on risk management and industrial development in October, 1988.

28 Pezzey, John, 1989. "Economic Analysis of Sustainable Growth and Sustainable Development". Working Paper #14, March, 1989, Environment Dept., World Bank.

even more significant, ecosystem processes, rather than just stocks of physical resources, need to be considered as resources and capital which should be conserved — as well as used more effectively through new technology. Differences in the area of rate limitations on the physical flow of matter and energy through the economy (out of, then back into the ecosystem at large) are also important. These need to be integrated into a common discipline. This would lead to a much more explicitly managed relationship between man and nature, sometimes still involving "trade-offs," but with better accounting of the true values of functioning natural systems to economies, this perception will decrease. The approach is still anthropocentric at its core; all this concern for nature is based on the fact that hurting nature is beginning to hurt economic man. Thus, the instrumental economic paradigm prevails, only it is enlarged to encompass some basic ecological principles in an attempt to maintain ecosystem/life support system stability for the support of sustainable development.

39. This approach has been called the "*Global Efficiency*" path.[29] It expands economic analysis with systems analysis methods. The model of the closed economic system is replaced with the "biophysical economics" model of a thermodynamically open economy embedded within the ecosystem: biophysical resources (energy, materials, and ecological processing cycles) flow from the ecosystem into the economy and degraded (non-useful) energy and other by-products (pollution) flow back out to the ecosystem (see Figure 3).[30] Energy efficiency in particular and resource conservation (or efficiency improvement) in general,[31] pollution prevention (rather than clean-up) technologies, restoration ecology, ecosystem and social health monitoring, and the "polluter pays principle"[32] are management strategies that will probably be implemented on a large scale. Correcting incentive and punishment systems in order to harness market forces for efficient environmental management is a major theme. *In essence, ecology is being economized.* Much of the work is focussed on "getting the prices (of all resources) right."

40. The mislabeling of various societal messes as "environmental problems" is in many cases what helps to perpetuate them, because it enables professionals to conceive of them as "externalities" to be solved, cleaned up, or managed by different people from those who were responsible for creating the messes, rather than as evidence of a faulty system of logic by which

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29 Sachs, Wolfgang, 1988. "The Gospel of Global Efficiency: On Worldwatch and other reports on the state of the world." *IFDA Dossier 68*: 33-39 (November-December).

30 Daly, Herman E., 1989. Op. cit.

31 IUCN, 1980. *World Conservation Strategy*, International Union for the Conservation of Nature and Natural Resources, Gland, Switzerland.

32 OECD, 1975. *The Polluter Pays Principle*, Paris, 117 pp. See also,
Kapp, K. William, 1950, 1971. *The Social Costs of Private Enterprise*. Schocken Books, New York.

society makes its choices (decisions). When they are fully internalized, they can be conceived of as "resource problems," but this too has limitations. The characteristics of problematic situations of practice, which increasingly can be seen in the myriad "problems" of development, are frequently mismatched with the nature of technical-economic rational logic and its tools on which professionals have come to rely. This leads to the need for a new, mutually positive synthesis of development and management of human-nature interactions for the future.

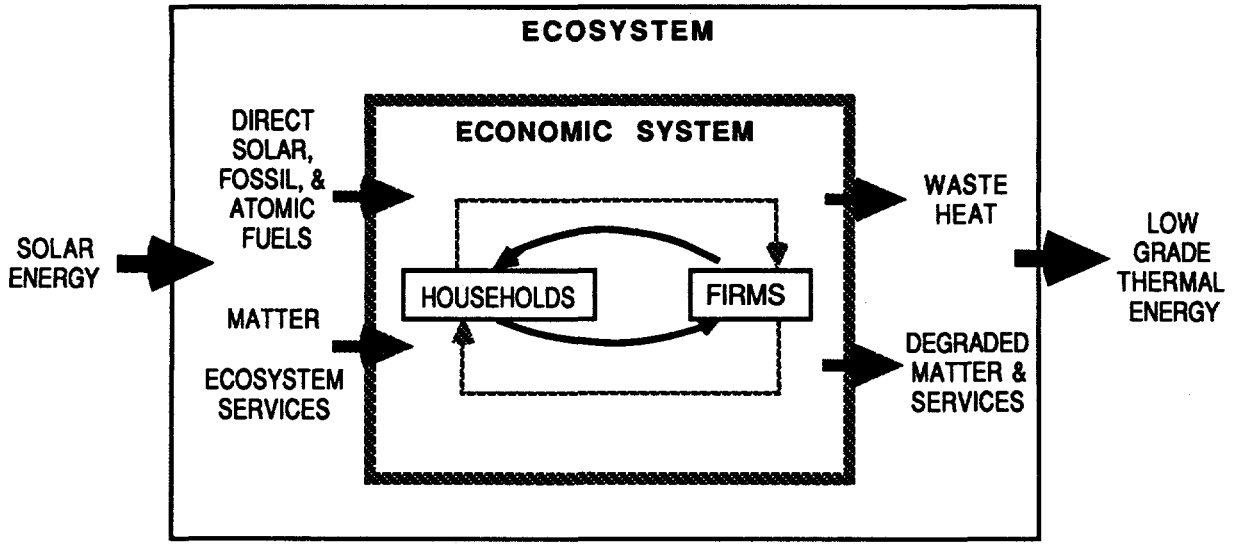

FIGURE 3. Economic Production from a Biophysical Perspective.
A continuous input of high-quality/low entropy fuels, varying entropy material ("natural" resources), and ecosystem services enter the economic system from the larger ecosystem. The economy then uses the fuels to upgrade the natural resources, driving the circular flow between households and firms in the process. The fuel, materials, and services are degraded and returned to the ecosystem as low quality, high entropy heat and matter and impaired ecosystem process functioning.[33]

Eco-Development

41. Eco-Development involves a larger, more discontinuous shift in thinking and practice than either of the two previous approaches, though again, it can be said to follow eventually from the limitations inherent to those paradigms. It more explicitly sets out to restructure the relationship

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33 Modified from Hall, Charles A.S, Cutler J. Cleveland, & Robert Kaufmann, 1986. *Energy and Resource Quality: The Ecology of the Economic Process.* Wiley-Interscience, New York; and Daly, Herman E., 1977. *Steady-State Economics.* Freeman, New York.

between society and nature into a "positive sum game" through sophisticated forms of symbiosis, compared to the back-to-nature "simple symbiosis" advocated by deep ecologists. It sees most development activity as a form of management of this relationship; environmental management, economic development, and socio-ecological development might virtually become semantic distinctions for the same subject: the integrated coevolution of conscious civilization and nature. Hence, "Eco-" signifies both "economic" and "ecological" (since both words come from the same Greek root), while the use of "Development" rather than "Growth," "Management" or "Protection" connotes an explicit reorientation and upgrading of the level of integration of social, ecological and economic concerns in planning.

42. Eco-development is not just about the clean up of pollution or prevention of excessive resource depletion, or efficiency of resource use, though these are certainly allowed and included, for practical reasons. Just as Environmental Protection includes and expands upon the system boundaries of Frontier Economics, and as Resource Management is doing the same for Environmental Protection, Eco-Development includes and expands Resource Management. Its real goal is to remove the need for the polluter to pay by restructuring the economy according to ecological principles. It would strive to make reality as close as possible to the theoretical neoclassical model of the environmentally closed economy (Figure 2). This is what Herman Daly's "steady-state" economics is about (though it is worth debating whether "steady-state" is too misleading a label). Growth is still possible, actually necessary, but it would be a very different kind of growth. Such *"green growth"* would be based more on increasing the information intensiveness, community consciousness, and experiential quality of economic activity, rather than the material-energy intensiveness. The global warming issue has great implications for energy development planning, as well as transport and agricultural systems — subjects of several forthcoming papers by World Bank staff. Eco-development would also attempt to incorporate many of the social equity and cultural concerns raised in the various schools of deep ecology. In *Sustainable Development: Exploring the Contradictions,* Michael Redclift argues that in order to take the work of the Brundtland Commission seriously, the direction of the development process itself must be redirected to give greater emphasis to indigenous knowledge and experience and to take effective political action on behalf of the environment.[34] Other major problems of the economic paradigm that still need to be resolved are the impacts on sustainability of time scales and discount rates, and integrating returns on different types of investments (e.g., financial, ecological, and social).

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34 Redclift, Michael, 1987. *Sustainable Development: Exploring the contradictions.* Methuen, London and New York.

43. Eco-Development would thus move on from *economizing ecology* to *ecologizing the economy*. From the conflict between anthropocentric versus biocentric values, it attempts to synthesize *ecocentrism:* refusing to place humanity either above nature (as in frontier economics, environmental protection, and resource management) or below it (deep ecology), it includes the ecological relationships among people and nature in communities, among communities sharing ecoregions, and among ecoregions cooperating to sustain the shared ecosphere of the planet.[35] It also needs to allow for the aspirations of all, placing equal value on ecology and creativity.

44. Eco-development requires even longer term management of adaptability, resilience, and uncertainty, to reduce the occurrence of ecological surprises caused by crossing over unknown ecospheric stock, flow-rate, and process thresholds. Ecological *uncertainty* needs to be incorporated into economic modeling and planning mechanisms; risk management (trying to figure out how much can be gotten away with) is not sufficient.[36] The polluter pays principle, widely regarded by economists as a major corrective mechanism, does not incorporate ecological uncertainty and social equity issues well at all. Eco-development would therefore make explicit social, ecological, *and* economic criteria for the development and use of technology (e.g., renewable, clean energy sources and energy conserving techniques; integrated pest management and low input agriculture; agro-forestry; and appropriate uses of biotechnology). It asks, "how can we create ecologically?" rather than "how can we create? and then how can we remedy?" The use of ecologically sound common property regimes and indigenous knowledge (e.g., sustainable extractive forest reserves, rather than clear-cutting for timber, cattle, and short-term cropping; effective common management of tribal drylands such as by the nomadic Samburu of Kenya; and the involvement of local peoples in the management and benefit-sharing of national parks and tourism, as with the Maasai in Kenya) would also be subject to such criteria. True costs of development would be fully integrated, allocated socially and internationally according to cumulative benefits, ecological uncertainty, and means (ability to pay).[37] In so doing, eco-development provides a *positive*, interdependent vision for both human development and nature.

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35 Tokar, Brian, 1988. "Social Ecology, Deep Ecology, and the Future of Green Political Thought," *The Ecologist, 18:* 4/5; 132-141, p. 139.

36 Perrow, Charles, 1984. *Normal Accidents: Living with High-Risk Technologies*, Basic Books, New York.

37 See, for instance:
Sachs, Ignacy, 1984a. "The Strategies of Ecodevelopment", *Ceres, 17*: 4: 17-21, (FAO).
Riddell, Robert, 1981. *Ecodevelopment: Economics, Ecology, and Development: an Alternative to Growth Imperative Models*, Gower, London.

45. Parallel to the rise of the afore-mentioned "systems analysis" schools of thinking in the early 1970's was an even more dramatic paradigm change. "Synthesizing" systems of planning and reflective action began to emerge, which eliminated the idea of "externalities" and simultaneously recognized the limitations of centralized planning.[38] There have been several variations, some more directly focussed on the integration of ecological and developmental goals than others. A basic commonality between them is the idea that planning ought to be embedded in the total environment of the systems being planned for, including all of the parties affected (stakeholders). In order to achieve improved conditions for both the system being directly planned for *and* its environment, global systems awareness must be coupled with local responsibility for action. This direct involvement of all concerned parties in the setting of goals, planning of means, and sharing accountability and benefits, is why decentralization is required, and what makes the process of "planning" more effective.[39] Interdependent autonomy, which may seem like an oxymoron, is promoted.

46. An early attempt to apply a synthesizing systems type of planning for environmental management was the International Joint Commission (IJC) of the U.S. and Canada's "Ecosystem Approach" to resolving environmental disputes along the 4000 mile border between those two nations. Though the "systemic design" aspect is sometimes limited by the dispute resolution character of the IJC's charter, the 1909 Boundary Waters Treaty,[40] the IJC now explicitly uses a stakeholder and positive-sum perspective in its approach. It is working on developing the ability to monitor and manage for ecosystem health, rather than for the doctoring of ecosystem dis-ease.[41] This relates to the concept of "removing the need to pay" for pollution, by removing the necessity to pollute.

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38 See, for instance:
Ozbekhan, Hasan, 1969. "Toward A General Theory of Planning", in Jantsch, Erich (ed.), *Perspectives in Planning*, OECD, Paris.
Ackoff, Russell, and Fred Emery, 1972. *On Purposeful Systems*. Aldine-Atherton, Chicago/ New York.
Ackoff, Russell, 1974. *Redesigning the Future: A Systems Approach to Societal Problems*. Wiley-Interscience, New York.
Passmore, William A. and John J. Sherwood, 1978. *Sociotechnical Systems: A Sourcebook*. University Associates, San Diego, CA.
Vergara, Elsa, Jamshid Gharajedaghi, & Russell Ackoff, 1980. "A Guide to Interactive Planning," *S-Cubed Papers, 80-4*, 51pp., Social Systems Sciences Dept., The University of Pennsylvania, Philadelphia.

39 Sagasti, Francisco, 1978. *Science and technology for development: main comparative report of the Science and Technology Policy Instruments Project*. International Development Research Centre, Ottawa, Canada, 112p., pp. 35-37.

40 Caldwell, Lynton K., 1988 (ed.). *Perspectives on Ecosystem Management for the Great Lakes*. State University of New York Press, Albany, NY.

41 Bandurski, Bruce L., Peter T. Haug, & Andrew L. Hamilton (Eds.), 1986. *Toward a Transboundary Monitoring Network: A Continuing Binational Exploration*. (2 Volumes) International Joint Commission, U.S. & Canada, Washington, DC.

47. Related to the idea of ecosystem health, James Lovelock is the father of the controversial, increasingly respected "Gaia Hypothesis" that the Earth is a self-organizing, self-regulating living system in which life actively develops and maintains the environmental conditions which sustain it. He has proposed a new science of "*geo*physiology," based on the marriage of biology, geochemistry, and atmospheric sciences.[42]

48. The positive vision of eco-development is for "*green growth*" and integrated co-evolutionary development of humans and nature.[43] The idea of co-evolution comes from studying the evolution of complex ecosystems with a high degree of species-specific symbiosis, or mutual dependence (e.g., tropical rainforests and coral reefs). Its application to the theory of environmental management and development is based on the recognition that man and nature are not nearly so separate as Western philosophy and approaches to governance have supposed. In fact, all human cultures have been altering ecosystems for millenia, while nature simultaneously exerted evolutionary pressure on human biology and on social systems. In the past few decades, however, humans have succeeded in altering ecosystems to a far greater extent, and in the process, have begun to degrade their capacity to function effectively. Eventually, perhaps quite soon given the strong likelihood of accelerating, discontinuous changes in the ozone layer and climate, the circle will close, leading to a "natural" degradation of human civilizations' functioning capacities.

49. It is easy to think of environmental management as a remedial cost. However, there are great economic and social benefits, not just environmental ones, that would accrue, particularly from the types of changes that a redefinition of development along the lines of good resource management and/or ecodevelopment would help promote. In the words of Ignacy Sachs,

> The existence of tradeoffs between environmental management and economic growth can not be denied, but their pervasiveness and intensity have been overrated, to the detriment of a search for the best of two worlds.[44]

In many cases, institutional and both individual and organizational behavior factors are more important than the economic ones cited in preventing the development of more ecologically sound

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42 Lovelock, James, 1979. *GAIA: A New Look at Life on Earth*, Oxford University Press, New York.
_____ 1988. *The Ages of Gaia: A Biography of Our Living Earth.* Norton, New York.

43 Norgaard, Richard B., Suzanne Easton, George Ledec, and Laurel Prevetti, 1987. "Social Organization for Sustaining Renewable Resources." Paper prepared for the World Bank, 134 pp., and
Norgaard, Richard B., 1988. "Sustainable Development: A Co-Evolutionary View," *Futures, 20:* 6; 606-620.

44 Sachs, Ignacy, 1984. "Developing in Harmony with Nature: Consumption Patterns, Time and Space Use, Resource Profiles, and Technological Choices", in Bernhard Glaeser, ed., 1984, *Ecodevelopment: Concepts, Policies, Strategies*, Pergammon Press, New York.

economies. One of the major factors contributing to the "economic miracles" of post-war West Germany and Japan is that fact that they were forced to completely rebuild their economic infrastructure with new, state-of-the-art technological production systems, as well as innovative ways of organizing the social (human) factors of production. While the United States had almost no competition in the first couple decades after the war because its production systems had not been destroyed, they eventually suffered in the newly competitive world marketplace of the 1970's and 80's, at least in part because their technological as well as social production systems were outdated. Change is often resisted due to behavioral and cultural inertia, despite economic imperatives. It is quite possible that in restructuring along the lines of eco-development, eco-technologies might bring new comparative advantages that will help to make those economies that are quickest and most effective at undertaking it more competitive and prosperous in the long run, rather than less so. Some developing countries might even be able to "leapfrog" over the "environmental protection" phase to a much more sustainable as well as self-defined state of development.

Changes in Context and Systems of Thought

50. In a broad sense, the five paradigms described above are distinguished by different conceptions of ecology, and varying degrees of inclusiveness and integration or operationalization of those conceptions. Those conceptions are embedded within different political, economic, biophysical, scientific-technological, philosophical, and social "environments," or *contexts*. Other possible future directions involve even greater emphasis on the aspect of changing worldviews, values, and therefore, politics. Longer term changes in environmental management and development thought based on even more recently emerging patterns of thought in science, philosophy, and politics that are quite discontinuous with those that historically have been predominant, may lead to quite fresh thinking and entirely new possibilities for the relationship between man and nature. These new directions are mainly philosophical in nature at this point in time, often based on still controversial advances on the frontiers of science and a shifting sociopolitical climate. But, as Chinese proverb says, "the philosophy of one century is the common sense of the next." In one interesting twist, the frontiers of science in some cases are proving to be quite compatible with very old ways of thinking and relating between man and the environment.

51. Space does not permit elaboration here, but further insights and changes in practice may be stimulated by emerging concepts from some of the following areas of science and philosophy:

- entropy (see Appendix);
- the afore-mentioned "geophysiology" (Lovelock's Gaia Hypothesis);
- physics (e.g., new theories of time, holonomy, new energy technologies);
- the marriage of ecology and psychology (e.g., Gregory Bateson, Morris Berman, and "reenchantment"[45]);
- paradoxical and other "non-rational" or "beyond technical rationalism" logics[46,47];

52. On the socio-political front, possibilities for great changes in both the availability of resources for environmental management and in the ways they are utilized are evolving so rapidly, it is almost dizzying. Three arenas from which new insights and changes in the feasibility of advances are particularly intriguing:

- looking at environmentalism as a political movement (Green politics); and
- the practice of environmental management in traditional, non-market economy cultures.
- changing ideas of "national security."

Changing Conceptions of National Security

53. In the introductory "Context" section of the paper, the Brundtland Commission and two articles on redefining national security to incorporate ecological stability as well as economic interests while recognizing a changing role for the military, were cited. "Environmental stress" has become a major source of political tension and military action in the world. Amongst the several ecological threats which may force such a redefinition are:

- growing numbers (millions per year) of "ecological refugees," often mistaken as political or military refugees, in many countries.
- the very real possibility of regional conflicts over water and other resources in the coming decades, particularly in the Middle East, where water shortages are becoming a

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45 Bateson, Gregory, 1979. *Mind and Nature: A Necessary Unity.* Bantam, New York. and Berman, Morris, 1981. *The Reenchantment of the World.* Cornell University Press, Ithaca, NY.

46 Hawk, David, 1986 (draft). "Regulation of The Non-Rational: Approaches to the Management of Environmental Quality", in Eric Trist (Ed.), *Plans Without Plans*, in press.

47 Miller, Alan, 1985. "Technological Thinking: Its Impact on Environmental Management." *Environmental Management 9:* 3; 179-190, p. 179.

more serious threat to peace than conflict over access to the region's petroleum (it is generally not acknowledged outside the Middle East, but water issues have already contributed to motivations for hostilities there on several occasions).

- the possibility of reaching the limits of the proportion of the Earth's net primary productivity (photosynthesis) that may be safely expropriated by man, perhaps sometime in the next half century as the world population doubles once again.
- discontinuous global climate variations causing disruptions in the world's most productive agricultural zones.
- major health crises due to ozone layer damage. (Scientific research indicates that the polar "holes" in the ozone layer that have appeared in the past few years are the result of chlorofluorocarbon use in the 1950's, which was trivial compared to that used in the past two decades; if that is the case, much greater damage can be expected, even if safe replacement products could be sweepingly introduced immediately. Similar processes are likely to be at work in the case of global warming.)
- the broad-scale loss of biodiversity and *in situ* genetic resources, particularly of the tropical rain forests and coral reefs, whose true economic and ecological values (as well as aesthetic and intrinsic) are unknown and underappreciated but certainly vast.

54. Past concepts of national sovereignty are no longer sufficient for a world altered by ever-increasing interdependence among nations on economic, ecological, and security fronts.[48] At the same time, major geopolitical forces (demilitarization of the East-West superpower conflict, directly in the North and indirectly in the Southern proxies) may complement an accelerating political will to divert attention and resources to this highly-needed redefinition. Additionally, another record-breaking summer in Washington, DC or drought in the U.S. bread basket will probably do much to accelerate the political feasibility of such a redefinition. The much-heralded, if tenuous, "resolution" of the East-West Cold War may free up vast financial, scientific/engineering, and diplomatic resources that could be redeployed to eventually lead to a resolution of a more significant North-South "Silent Resource War" which has been brewing for a long time, but whose expression was hardly allowed due to the self-absorption of the North in its East-West ideological and geopolitical conflict. Even if this does not translate to more direct transfer of resources to the South (desperately needed), if it were to lead to a redefinition of development and massive restructuring of the industrial economies along the lines of the resource management and/or eco-development paradigms, this would give the South more freedom to utilize

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48 Lebel, Gregory G. & Hal Hane, 1989. *Sustainable Development: A Guide to Our Common Future.* Global Tomorrow Coalition, Washington, DC.

its natural resources sustainably for its own development, rather than for simple export to Northern markets. It could also allow far more equable forms of collaboration and a search for new economic roles for all nations to play in creating an integrated, sustainable relationship between civilization and nature, which would benefit all concerned.

Changing Values

55. Implicit in much of this discussion has been the notion that the rise of environmental management means an evolution in societies' value systems is happening. The degree of anthropocentricity in the fundamental relationship between humans and [the rest of] nature is an indicator of modifications in ultimate values. Values (other than monetary ones) are very hard to deal with; perhaps this is why economists have tended to shy away from such discussions, and treated them as if they do not change. But values are clearly a major aspect of what development is about, and they do change; the rise of significant "green" political movements in Europe, Australia, India, and Brazil, not to mention the current struggles for change in the Soviet and Chinese systems are obvious examples.

Conclusion

56. Figure 1 and Table 1 (pages 6-7) provide a working summary of the five paradigms. It should be remembered that the paradigms presented here are not separate species. As is appropriate in times of great change, there is an increasing amount of fluidity between them. No single paradigm has the best answer to every type of environmental management or development problem. As the newer paradigms evolve, they incorporate much of the older. There are also two types of evolution entwined in this discussion: that of the historical *evolution of the concepts and tools* within the particular paradigms, presented here somewhat artificially as separate, for purposes of distinction, and that of the historical *progression in the dominance of their use*. If the paradigms are thought of as separate populations, rather than species, it may be seen that each is evolving through changing "selective pressures" imposed by different and changing *user groups* and *problems*. Depending on the user group and the problem(s) they are concerned with, each paradigm is influenced differently by the introduction of new ideas. In addition, the user groups themselves are also evolving in the context of both their paradigms and their perceived problems (or realities), which feeds back to both the evolution of the paradigms and of their use.[49]

57. So, paradigms of environmental management are in a period of flux. The defensive (remedial) agenda is breaking down, in no small ironic part because of its ineffectiveness in dealing with the negative consequences of unmodified frontier economics and development. The serious push at the neutral (resource management, systems analysis) agenda very recently has begun to get under way, politically. The widespread perception at this time is still one of tradeoffs between environment and development. However, this is a pernicious and unnecessary assumption. There are great economic and social benefits to be obtained from fully integrated approaches to environmental management.

58. Still on the fringes are small but growing pockets of advocacy for the more positive approach, be they through the synthesizing-systems planning methodologies, or the contextual, philosophical and values-based approaches of what are today some leading edges of science. It is possible that the growing sense of alarm about global climate change and ozone layer disruption may cause a more rapid evolution from Resource Management to Eco-Development than it is politically expedient to advocate at this time. The co-evolutionary approach would require

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49 The author would like to acknowledge and thank Richard Norgaard for discussions about the co-evolutionary nature of the paradigms and their users, as well as of the relationship between man and nature.

inclusion of all user groups, or stakeholders, in the development of future environmental management and development strategies.

Possibilities for Convergence

59. It is hypothesized here that the three sets of conditions embodied in the unprecedented degree of threat of global changes in the ozone layer and climate issues, widespread problems of resource depletion/degradation, and the easing of the military and ideological competition between the superpowers, allowing for a redefinition of "security" and redeployment of resources for its achievement, may provide the necessary and sufficient forces for a synthesis or convergence to a paradigm along the lines of eco-development to emerge. The path to such a synthesis may involve evolutionary learning and cross-over between the paradigms presented here, or it may occur as a more revolutionary change to one of these five, or yet another, becoming predominant in its own right. Widespread political paralysis which will prevent effective cooperation and institutional innovations of the magnitude needed to meet the great challenges of the coming decades may be the result if some synthesis does not surface as a vision for the future development of both industrial and developing societies. Time might appear to be on the side of ecodevelopment. On the other hand, it may be that paradigms are impervious to evidence, institutions and societies too difficult to change, and the adherents to each will go on talking past each other, avoiding the real discussions (and conflicts) that are necessary to ultimately achieve a synthesis. Whether, how, and if so, when it resolves these issues may be the most significant test of modern civilization.

Appendix: Some Working Definitions

Paradigm:

(1) an accepted model or pattern ...as an object for further articulation and specification under new or more stringent conditions;

(2) a criterion for choosing problems ... that can be assumed to have solutions. Other problems are rejected as metaphysical, as the concern of another discipline, or sometimes as just too problematic to be worth the time;

(3) the entire constellation of beliefs, values, techniques, and so on shared by members of a given community, or one element in that constellation, the concrete puzzle-solutions which, employed as models or examples, can replace explicit rules as a basis for the solution of the remaining puzzles of normal science;

(4) a time-tested and group-licensed way of seeing;

(5) not the same as shared rules; the existence of a paradigm need not even imply that any full set of rules exists.[50]

Development: a process of progressive societal (therefore involving equity and political issues) and economic transformation, the major objective of which is the satisfaction of human needs and aspirations, usually achieved by increasing productive potential (growth) and equality of opportunity.[51]

Sustainable Development:

(1) "a pattern of social and structural economic transformations which optimizes the economic and other societal benefits available in the present, without jeopardizing the likely potential for similar benefits in the future."[52] or,

(2) "development that meets the needs of the present without compromising the ability of future generations to meet their own needs. ...A process of change in which exploitation of resources, the direction of investments, the reorientation of technology development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations." [53]

(3) Related terms: Hicksian *income*: "the maximum amount that a person or nation could consume over some time period and still be as well off at the end of the period as at the beginning. Income equals maximum sustainable consumption."[54] This does not consider the phenomena of time lags between activities and ecological effects, however; hence, the issue of economic discount rates is still a serious matter to be resolved. Ecology and economics presently have very different concepts of what *production, capital, health*, etc. mean. These need to be integrated into a common discipline. Also, the distinction between "*sustainable*" and "*sustained*" is

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50 Kuhn, Thomas S., 1970. *The Structure of Scientific Revolutions, 2nd Edition*. U of Chicago Press, Chicago.

51 World Commission of Environment and Development, 1987. *Our Common Future*, Oxford University Press, Oxford & New York.

52 Goodland, Robert, and George Ledec, 1987b. "Neoclassical Economics and Principles of Sustainable Development", *Ecological Modelling, 38*: 19-46; p. 36.

53 WCED, 1987, Op. cit., p. 43, 46.

54 Daly, Herman E., 1989. "Sustainable Development: from concept and theory towards operational principles", *Population and Development Review*, Hoover Institution, in press.

important. What has been sustained in the past is not necessarily sustainable into the future.

Environment: the complex of biotic, climatic, soil, and other conditions which comprise the immediate habitat of an organism; the physical, chemical and biological surroundings of an organism at any given time.

Environmental Management: the field that seeks to balance human demands upon the Earth's natural resource base with the natural environment's ability to meet these demands on a sustainable basis.

Ecology:
(1) the study of the interrelationships between living organisms and their biological, physical, geological, chemical, and geographic environment (reductionist); or
(2) the study of the structure and function of nature (holistic).[55]

Economics:
(1) the study of allocating the resources available to society in a way that maximizes social well-being (common neoclassical definition).
(2) "the wise and legitimate government of the house for the common good of the whole family ... extended to the government of the great family, the State." (Rousseau)[56]

Resource: any component of the environment that can be utilized by an organism.

Entropy: a measure of unavailable energy, or disorder, in a closed system

Energy: the capacity to do work; except that high entropy (highly disordered) energy has no capacity to do work.

Ecosystem: a particular community of organisms and their physical environment interacting as an ecological unit.

Ecosphere: or biosphere; the sum of all the Earth's ecosystems — the complete biotic (living) and abiotic (non-living) components and processes of interaction which exist or take place on the planet.

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55 Odum, Eugene, 1953. *Fundamentals of Ecology*, Saunders, Philadelphia.

56 Bandurski, Bruce L., 1973. "Ecology and Economics-- Partners for Productivity", *Annals of the American Academy of Political and Social Science, 405*: 75-94, Philadelphia, p. 81.

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