Sustainable Development and Social Change : Theory and Practice

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Ⅰ. Introduction

This paper concerns society-environment interactions, and particularly the possibilities of sustainable developmental social change within the biophysical environments of human societies. The concept of 'sustainable development' has a long and mixed history, and has in the last decade transcended the specialized language of scholars, to become a common goal or at least an irresistible slogan in public discourses about meaning and conflict about the on-going environmental impacts of human societies. I first address definitional questions. What is sustainable development? Conceptually and abstractly, the matter is quite simpl : Sustainable means that the change process or activity can be maintained without exhaustion or collaps; development means that change and improvement can occur as a dynamic process (Southwick, 199 : 96). It does not mean profligate use of the natural world

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without regard to the future, but neither does it imply a static condition. In human terms it means inventing ways of meeting human needs while preserving the capacity of the biophysical environment to do so. A sustainable society "can persist over generations without undermining either its physical or its social systems of support" (Meadows and others, 1992 : 209). In more human terms a sustainable society would be one that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987).

Historically the notion of sustainable development probably seemed like a nice utopian idea, but not very practical. After all, human populations were smaller, economic technologies less powerful, and nature's bounty seemed infinite. Since 1950 population has doubled, and may double again in the next 20 years. Global economic output has quintupled. The cultural ethos of consumerism that favors high growth and ever-rising consumption is rapidly diffusing around the world (being led by example and exhortation by the world's premiere consumers in the U.S.A. !). At the same time the chasm of inequality grows both within and between nations, and poverty proliferates while the prospects for global equity seem increasingly remote. There are signs that every environmental and ecological system is becoming degraded. Today the earth's 5.8 billion people manage to erode billions of tons of fertile topsoil annually, measurably threaten the biodiversity in most ecosystems, produce pollutants sufficient to cause widespread public health hazards, and consume so that supplies of water and food are becoming increasingly "tight" and expensive in many parts of the world. Additionally, human activity is linked to significant climate change-with damaging but unforeseeable consequences (Southwick, 1996 : 92-93). I therefore argue that today practicing sustainable development is not just a "nice idea" but a vital necessity for viable human futures for the people's of the world-certainly futures that are materially secure, reasonably equitable, and democratic.

Few would disagree in the abstract with the desirability of a sustainable society. But when considering the particulars of policy it is a notion that engenders rancorous conflict (To put it mildly !). Consider the conflicts of interest genefated by public

policy debates about whether to encourage or dampen material consumption of a particular product or service, whether to restrict the production of environmental toxins and pollutants, and who should pay the costs of doing so, or what resources, if any, should be held "in trust" for future generations. In public discourse sustainable development and associated notions like the "carrying capacity" of the earth turn out to be universally supported but inherently politicized concepts. Resulting controversy generates different advocacy organizations (NGO's, social movements) with different objectives, resources, and political influence. In the U.S. for example the Sierra Club and the Sahara Club have similar names. The Sierra Club is a well known influential environmental movement organization that promotes environmental preservation and conservation, and living within sustainable limits. The Sahara Club was formed in the late 20th century by American interest groups fed up with "pious environmentalists" trying to take away individual freedoms, eliminate jobs, and the nation's economic strength. In it's view humans are masters of the earth, and its resources should be exploited for human use (Southwick, 1996 : xix).

Even among scholars - many with "pro - environmentalist" orientations - notions like sustainable development and carrying capacity are contentious. Sociologist William Catton is convinced that the earth has a finite carrying capacity, and that we have already exceeded it (1997 : 175 - 78). Others have argued that there is no such thing as sustainable development, being a rhetorical and ideological term for those who wish to continue destructive growth and "feel good about it." Lester Brown and Donella Meadows believe that we may have already exceeded the earth's carrying capacity, but continue to "hedge their bets" (Brown, 1996; Meadows, 1992). Economist Julian Simon has for decades been a tireless advocate of the idea that there is no finite carrying capacity, and that development and growth in material consumption should be vigorously promoted to proceed as it has for the last 50 years (1981). Finally, theoretical biologist Joel Cohen, argues that notions like sustainable development or the carrying capacity are important but not concepts with any objective scientific utility (1995). He argues that question like "How many people the earth can support?" are inherently normative and value laden. At what

levels of material well-being? At what economic consumption levels, with what material technologies? Living in what kinds of biophysical environments? And with what kinds of cultural values, political, and legal institutions? While I accept Cohen's view, I don't believe it makes a goal of sustainable development irrelevant. I think it is increasingly the supremely important consideration for social policy, but it requires humans to address difficult normative and value questions like Cohen raises. But then, social policy discussion often boil down to normative considerations.

Ⅱ. SOCIAL AND ENVIRONMENTAL FUTURES : TWO COMPETING VIEWS

Two views of social and environmental futures reflected these controversies since the 1940s, and they contend for legitimacy and to shape policy.[1] They continue, and here I outline them only briefly.

Suppose the trends noted above continue. Can they do so without devastating the carrying capacity and resource base of the planet (in terms of any reasonable criteria for human security and well-being)? If trends continue, will homo Sapiens thereby replicate a global scale the "outbreak-crash" familiar to ecologists and population biologists?[2] Or will humans be able to invent and "grow" our way into a sustainable high-consumption world for very large numbers of people? Can a projected 10 billion people emulate the consumption habits and lifestyles of contemporary Europeans or North Americans? A traditiona "finite world" paradigm

1) The following section is adapted from Harper, 1996 and 1998. They also include brief histories the controversy.

2) Illustrations of the "outbreak-crash" phenomena abound. When bacteria are introduced to a nutrient-rich petri dish, exuberant growth follows. But in the limite "world" of the dish, such growth is not sustainable. "Sooner or later, the bacterial populations deplete available resources, and submerge in their own wastes, their initial blossoming replaced by stagnation and collapse" (Clark, 1990 : 1). But you don't have to reply on such analogies. David Klein's study of reindeer documents the introduction of 29 animals, minus wolves-their natural predators-to remote Matthew Island off the coast of Alaska. In the next 19 years, they had multiplied to 6,000 animals and then, through starvation had "crashed" to 42 in the following three years. When discovered the 42 reindeer were in miserable condition, all probably sterile (Klein, 1968 : 350-367).

of most ecologists, physical scientists and demographers argues not, but an alternative "market resource allocation" paradigm argues that indeed it is possible and probable. This second view represents some (though not all) neoclassical economists, and finds powerful political support among business and industry groups, particularly those representing the energy, manufacturing and extractive industries, and reflects the dominant environmental views of the more conservative majority in the U.S. House of Representatives (since 1994). In this view, if we simply let markets operate, the price mechanism will regulate scarcities and stimulate investment in efficiency and innovation. Given human technological ingenuity and "elasticitics of substitutability, things will work out. The finite world paradigm views profligate growth as a prelude to disaster, and sees technological innovations as allowing (rich nations) to make only "Faustian bargains"[3] The resource allocation paradigm holds that environmentalists, and attempts to dampen material growth and consumption are the real threats to continued human progress. These conflicting views of the trajectory of social and environmental futures have been around in Western intellectual and political circles since the 1940s, and each have sophisticated intellectual articulation, and both have contemporary defenders.

1. A Future Without Limits : Cornucopia?

Since the 1960s, Herman Kahn (the late director of the Hudson Institute) and his colleagues argued that universal affluence and permanent growth are possible and the most probable long term outcomes of present trends. They argue that most people in the world can, in fact, live like contemporary Americans and Europeans without devastating the planet. They argued that "- barring bad luck or mismanagement - the prospects for achieving eventually a high level of broadly worldwide economic affluence and beneficent technology are bright, and that this is a good and logical goal for mankind ···" (Kahn and Phelps, 1979 : 202). How so?

3) The term Faustian bargain derives from the monumental fictional work by German writer Johan Wolfgang von Goethe (1949 - 1832) about a tragic figure, Faust, who sells his soul to the Devil for pleasure, wealth, and power while he lives but finds himself condemned to hell for eternity. He bought short - term gain for long - term damnation.

Taking a very long view, they argued, we are now in part of a great transition that began with industrialization in the 1700s. "In much the same way that the agricultural revolution spread round the world, the Industrial Revolution has been spreading and causing a permanent change in the quality of human life. However, instead of lasting 10,000 years, this second diffusion process is likely to be largely completed with a total span of about 400 years or roughly by the late 22nd century" (Kahn, Brown, and Martel, 1976 : 20).

Kahn expects the general pattern of the great transition to follow an S-shaped curve. From the 1800s there were exponential increases in world population and exponential increases in world population, the "gross world product" (GWP),[4] and per capita incomes. Beginning in the 1970s there was, and will continue into the future, a leveling of world population growth (rate !) and a decline in previously exponential rates of world economic growth, but a continuous spread of affluence so that world per capita incomes will continue to increase. Kahn and his colleagues are at pains to stress that the slowing of economic growth will occur because with the spread of affluence, there will be a reduction in the growth of demand, rather than shortages of supply.

Global inequality above is what Kahn and his colleagues viewed as a "transitional gap" between the living standards of the poor and the rich nations. They think this is inevitable as industrialism spreads and living standards of some parts of the world rise relative to others. But that is analogous to the widespread misery and poverty of early industrialism, which eventually spread better living conditions to many people in industrial societies. Kahn's depiction of the great transition in terms of his estimates of changes in population growth, the GWP, and per capita incomes.

While they do not ignore the problems of the present, Kahn and his colleagues have little patience with those who view contemporary problems in apocalyptic terms. Reacting to one such report (Global 2000, a Report to the American President, 1979) they responded that

4) Kahn's term for all the GNPs of the world taken collectively.

> Global problems due to physical conditions ··· are always possible, but are likely to be less pressing in the future than in the past.. Environmental, resource, and population stresses are diminishing, and with the passage of time will have less influence than now upon the quality of human life on our planet.
> These stresses have in the past always caused many people to suffer from lack of food, shelter, health, and jobs, but the trend is toward less rather than more of such suffering. Especially important and noteworthy is the dramatic trend toward longer and healthier life throughout all the world. Because of increases in knowledge, the earth's 'carrying capacity' has by now no useful meaning. These trends strongly suggest a progressive improvement and enrichment of the earth's natural resource base, and of mankind's lot on earth (Kahn and Simon, 1980, cited in Simon, 1983 : 13).

In a nutshell, this is an optimistic view of the future accepts the present trends as basically benign. It is a cornucopian view of the future. Kahn and his colleagues have taken a clear "human exemptionalist" view, that humans are essentially "exempt" from the limits of nature (Dunlap and Van Liere, 1984). With faith in human good will and inventiveness, they see no reason to deflect or attempt to change the course of social change that has been in effect since the 1600s. As you may imagine many analysts are attracted to this view, which posits the possibility of universal affluence and progress. (For examples, see Zey, 1994; Simon, 1981; 1994; Naisbett, 1982, 1994. With special reference to America, see Cetron, 1994).

2. A Future With Limits : Outbreak - Crash?

The counterpoint to the cornucopian scenario argues that present trends are putting us on a collision course with the finite carrying capacity of the planet, which we may "overshoot." As noted above, some argue that we are already in an overshoot mode. If so, we must dramatically reverse the historic trends of the past 200 years or inevitably suffer a collapse of human civilization because of a collapse of the resource base on which it depends. The most articulate, influential, and controversial statement of this view was by a 1970s futurist think tank called the Club of Rome, sponsored by a variety of industrialists and multinational corporations. Rather than

rely on the mental and intuitive models of Kahn and his colleagues, the methodology of the Club of Rome used an elaborate computer simulation called a World System Dynamics (WSD) model developed by Massachusetts Institute of Technology (M.I.T.) scientists Jay Forrester, Donella Meadows, and colleagues. This model started with what was known about current patterns and trends in population growth, economic growth, resource consumption, food supply, and pollution effects, each of which has been growing exponentially. The WSD model then developed an elaborate set of coefficients for how continued growth in each of these areas would impact the others, and attempted to project the sum of these interactions into the future for several hundred years (see Meadows et al., 1972).

The resulting projection by the WSD model was a classic outbreak-crash model. The human outbreak-crash pattern predicted by the WSD model argues that current exponential growth in population, resource consumption, and food production will produce such enormous stress on the carrying capacity of the planet by 2100, that the resource and capital inputs to support such consumption levels will not be sustainable. Capital investments can no longer keep up with the growing needs. This prevents increases in fertilizer production, heath care, education, and other vital activities. Without food and necessary services, world population and living standards will undergo a steady decline sometime during the twenty-first century (Humphrey and Buttel, 1982 : 97-98). Thus the Club of Rome research group argued that, on a global basis, the whole of humanity will replicate the more limited ecological crash experience of the Copan Mayans, the Mesopotamians, the Western Roman Empire, and many other preindustrial societies. In their degraded environments they could no longer obtain the investments necessary for social maintenance (see Harper, 1996, Chapter 2). The views of the Club of Rome research group have been forcefully stated in a variety of technical and popular publications (Meadows et al., 1974). The most recent report by the group using more recent data is significantly entitled Beyond the Limits, and argues that we have already overshot the earth's carrying capacity and are now living with a dwindling resource base (Meadows and others, 1992).

At some time shortly after the turn of the next century (2100), growth would

be unsustainable. The problem was not any single dimension but the cumulative effects of the way that they interact. And the underlying problem is growth itself. Hence the M.I.T. researchers emphasized the urgency of global efforts to dampen exponential economic growth itself (not just population growth and pollution side effects) and move toward a "global equilibrium." The language of the steady state, used in earlier versions of their scenario, has been replaced with the language "sustainability" in which they take pains to point out that certain types of growth are possible, so long as there are dramatic reductions in material consumption. In this view, it is not enough to simply wait for markets to adjust to scarcity of food and nonrenewable resources : By that time irreversible declines in ecological equilibrium and resource availability may have already taken place, and a variety of points of no return may have been passed. Nor can technology save us. All that technological advances can do is delay the inevitable, since dominant cultural patterns and institutional arrangements perpetuate and "problem - solving - by - growth" that are in the end self - defeating. The specter raised by this vision is that, if present trends continue, after 2100 a smaller human population will be eking out a more marginal existence on an exhausted and polluted planet.

This is indeed a sharp counterpoint to the cornucopian view of the future presented by Kahn and his colleagues. It is a darker and more pessimistic scenario about the future, and as you might imagine, has provoked a blizzard of commentary and criticism over the years. For instance, earlier versions predicted impending depletion and cost increases of several mineral resources that have not occurred (many are more abundant and cheaper than they were in 1970). Indeed the subject of mineral resources is treated in a much more nuanced fashion in later publications, often emphasizing sink rather than source problems. On the other hand, the Club of Rome group's projections about the availability of other types of resources (such as water, arable land per capita) seem, in the retrospective of 20 years, on target. Other attacks on the perspectives of the Club of Rome groups have been more political and ideological than scientific. They have been attacked as providing the justification of a planned and rationed world socioeconomic order, an anathema to conservatives and free - market economists, as well as those on the political

left as providing justification for halting growth and thus betraying the aspirations of the world's poor. Indeed, though the Club of Rome has recognized the importance of "distributional problems" in a transition to sustainability with equity are absent.

3. Cornucopian or Finite World Futures : Evidence?

Empirical evidence is not irrelevant to this "granddebate" about society-environment interaction, but neither is it the sole basis on which it is addressed by public policy. Evidences, of different kinds are typically marshaled by the defenders of each view (for a more detailed examination, see Harper 1996, Chapter 7). The defenders of the cornucopian view note the very great "elasticities of substitution," both historic and potential, in industrial and energy resources. They note that, contrary to the Club of Rome predictions, many minerals, including fossil fuels are more plentiful and cheaper than the where in the 1970s. Defenders of the "limits" view respond that while true, the cost-supply-accounting calculations about minerals and their price do not include the costs of "externalities," and that the most serious problems with industrial minerals have to do not with source but with sink problems (pollutants). They note the on-going pollution of water, declines in biodiversity, and the effect of greenhouse gasses on the climate (as evidenced by the recent climate conference in Kyoto). Moreover, defenders of the limits point not to industrial minerals, but to per capital declines in agricultural resources (arable soil, water) used to produce food, including the world's 17 fisheries. Agricultural resources are being seriously over exploited, and food per capita is becoming less available and more expensive, though that may not be noticed among the affluent classes in rich nations for some time-if ever.

But you can pick (or manufacture) your own evidence. Evidence will have something to do with how nations individually or collectively deal with these problems, but not everything.

4. Understanding the controversy

How can different analysts disagree so much about the future? How do they do so, even when they look at the same world, and sometimes use the same facts? Which view has the closest approximation to actual world futures? The debate

is often sterile and unproductive, with each side grasping a portion of the truth, but not the whole truth. Still, it is an important controversy to understand, not "just one for scholars," but for people around the world and their children.

Part of the answer has to do with differences in the mindsets of the two groups of analysts, who by their training have learned to think about the world in different ways. They have different paradigms for "the way the world works." Scenarios emphasizing future limits were created by persons from a variety of scientific backgrounds, including population experts, environmental scientists and ecologists, hydrologists, physical scientists and geologists, mathematics and computer modelers, soil scientists, biologists, climatologists, and some social scientists. There is, I argue, an emerging consensus among the organized scientific bodies of the world about the importance of attending to the issues of limits and sustainability (Union of Concerned Scientists, 1992; Scientific Advisory Committee, U.S. Environmental Protection Agency, 1990 : 17). Consider the following statement by Frank Press, President of the U.S. National Academy of Sciences :

> Human Activities are transforming the global environment, and these global changes have many faces : ozone depletion, tropical deforestation, acid deposition, and increased concentrations of gases that trap heat and may warm the global climate.
>
> For many of these troubling transformations, data and analyses are fragmentary, scientific understanding is incomplete, and long-term implications are unknown.
>
> Yet even against a continuing background of uncertainty, it is abundantly clear that human activities ··· now match or even surpass natural processes of change in the planetary environment (cited in Silver and DeFries, 1990 : iii-v).

Most remarkably, in 1992 the U.S. National Academy of Sciences and the Royal Society of London, two of the world's most prestigious scientific organizations, neither known for taking extreme stands, issued an unprecedented joint statement that "advances in science and technology no longer could be counted on to avoid either irreversible environmental degradation or continued poverty for much of humanity" (1992). Scenarios emphasizing more optimistic "cornucopian" futures were created by economists, business people, technical experts in management, and journalists. Clearly, the two groups of analysts look at the same situation from different points of view (Brown, 1991 : 5-9; Harper, 1996 : 48-58).

Another part of the answer to these questions has to do with the selectivity of people's view of the world and its future. No scholars or writers are completely exempt from selectivity. For example, you can view the U.S. and see tremendous progress in science, education, economics and well-being. Or you can see alarming problems of urban ghettos, homeless populations, toxic waste dumps, and social decline. What is the "real" truth? For whom? Selectivity is even more of a problem when viewing the world. It is perfectly possible to tour the world by jet aircraft and air-conditioned taxi, staying in luxury hotels and come away with the impression of great progress and prosperity. Likewise, you can tour the world visiting urban slums, refugee camps, exhausted deserts, areas of war and terrorism, and conclude that the visions of doom are here to haunt us today (Southwick, 199 : 88).

Considering this, it is no wonder that different analysts can look at the world today, think about the future, and reach totally different conclusions. Between scenarios written by the emerging consensus within scientific communities and those written by business leaders, economists, and journalists, who do you trust the most to sort through facts and fancies, and to come to grips with objectivity and reality? I cited official statements by the world's most respected scientific communities, and about these issues I have more faith in them than I do in industry spokesmen, elected politicians, or environmental journalists. But they do provide a key insight : We should focus on human ingenuity to increase limits, as well as the limits themselves. Many societies adapt well to scarcities and problems and often wind up better than they were before. The limits the world faces are a product of both its physical context and the ingenuity it can bring to bear on that context. But we may face a widening "ingenuity gap," and some parts of the world are locked into the rising need for ingenuity and the limited capacity to supply it (Homer-Dixon, 1996 : 365).

Ⅲ. WHAT WOULD BE SOME CHARACTERISTICS OF SUSTAINABLE SOCIETIES?

Granting that it is prudent for nations and the world community of nations to pursue sustainable development with great vigor, it is important to more concretely

describe the characteristics of "sustainable societies" compared to the highly abstract definitions with which I began. As a disclaimer, I don't believe that there has ever been a truly sustainable human society since Neolithic times (Ponting, 1991). But it is important to spell out what they would be like if they did exist. Further, it is impossible to say exactly what policies would move nations and the world in that direction. These will necessarily vary by culture and political-economy. But I will try to identify some trends and policy illustrations from different nations in the remainder of this paper.

I think there are 7 sociocultural dimensions of sustainability. Some obvious, but some perhaps not so obvious. They involve (1) population, (2) the biological base, (3) energy, (4) economic efficiency, (5) social forms, (6) culture, and (7) world order. After discussing these, I will examine community resource management strategies that may be to encourage sustainable development related to some of these characteristics.

1. A sustainable society would dampen population growth and stabilize its size. This is particularly important in the poorer developing nations. There, dense populations and the momentum of growth, even with a slowly falling growth rate, underlie the poverty and desperation which impel environmental disruption, political conflict, and destabilizing waves of refugees and migrants. Achieving a stable population implies policy initiatives that provide people with access to contraception and family healthcare, and control resources necessary to alleviate the worst material insecurity-particularly those that reduce gender inequality (United Nations, 1994; Population Reference Bureau, 1997 : 4-5). East and Southeast Asian nations provide the most successful programs for population stabilization in recent decades.

2. A sustainable society would conserve and restore its biological base, including fertile soil, grasslands, fisheries, forests, and fresh water bodies and water tables. In so far as possible, a sustainable society would design agriculture to mimic nature in its diversity and natural organic recycling, rather than overwhelm and degrade agroecosystems with monocultures and industrial chemicals. It would respect and preserve significant "wild" ecosystems both for both ethical/ aesthetic reasons as well as utility for human uses. Preserving or restoring the biological

base might include policy initiatives that define and provide incentives for using such resources only at sustainable rates. In the U.S., initiatives to slow soil erosion and improve water and air quality provide models - if imperfect ones - but pursued by strategies mainly available to richer nations. Other initiatives might involve facilitating local and regional "community resource management," with or without formal sanctions, to which I will return.

3. *A sustainable society would gradually minimize or phase out the use of fossil fuels.* It would restrict the use of coal and petroleum, and shift to natural gas as an interim (but less polluting) carbon fuel, and eventually depend more on energy from a wide variety of renewable energy sources as determined by local conditions (including hydrogen fuels, solar, wind, geothermal, biomes, and hydroelectric). In the long term, sustainable societies would be powered more by sunlight and hydrogen than carbon. Cogeneration, the combined production of heat and power would be widespread, and many factories would generate their own power, using the waste heat for industrial processes. Technological possibilities abound, but the main barriers to moving toward sustainable energy systems are political - economic, given the enormous market domination and political leverage exercised by the petrochemical industries. Ways must be found to provide in fact alternative energy firms with "level playing fields" to enter markets and compete, and policy initiatives would include stimulating markets for energy efficiency and cogeneration. How this could be done would vary according to the political - economies of nations. Promoting alternative energy systems has been most successful in Northern and Western Europe, but there are great potentials in many less developed regions of the world, which are rich in sunlight, wind, biomass, or other resources for alternative energy systems.

4. *A sustainable society would become economically efficient in all senses.* It would invest in the technology and production of efficient vehicles, transportation systems, machinery, offices, and appliances. It would maximize the recycling of material and wastes. More fundamentally it would reduce the waste in processes of production, packaging, and distribution of goods and services. It would reduce waste by reducing the material component of goods and services. Such

dematerialization could create a permanent net drop in per capita wastes and resources consumed. Durable rather than consumable ones would be emphasized. In a truly sustainable economy the principle source of materials would be recycled goods. Both producers and consumers would create an economy that functions more like an ecosystem, cyclically, rather than in a linear way that withdraws from sources and throws away junk in environmental sinks (Frosch and Gallopoulos, 1990). I believe the Germans made to this date the greatest progress in moving toward an "economic ecology" through their vast and effective recycling systems, and the Japanese have made the most significant long term investments in technological efficiency (at least before the recent recessionary period in the Japanese economy!). While some kinds of efficiencies are possible only by wealthy nations, traditional practices and technologies in less development nations often turn out to be surprisingly efficient when considered in full ecological (rather than commodity cost-accounting terms). The challenge is to stimulate efficiencies that combine the best from traditional practices and "high" technologies.

5. *A sustainable society would promote social forms compatible with these natural, technical, and economic characteristics.* A mix of coordinated decentralization and flexible centralization would exist. Thus entrepreneurialism and "small scale" networks would flourish along with large organizations and urban life. People would come to understand that small is not always beautiful and large is not always ugly (Lewis, 1992 : 254). Transportation systems would become an efficient mix of different modes, including autos, ride sharing programs, mass transit, and bicycles. High - density settlement would be encouraged, and "urban sprawl" would slow or contract. Multiple rather than single family dwellings units would be encouraged and dense community networks would emerge in social life to compensate and supplement large - scale mass markets. Social inequality would persist in a reasonably free sustainable society, but a sustainable society would establish social policies to inhibit both grinding poverty and redundant material wealth. Economic profits and productivity would be measured more by services related to the quality of life than the volume of material consumed. Recycling and environmental services themselves would become important industries, as they have in Germany, noted earlier as having undoubtedly the world's premiere recycling systems. New

forms of crime would emerge ("exploiting the commons"), and ecological problems would become as politically important as economic ones. Many nations today have such laws, but they are difficult to enforce almost everywhere. No nation has attended to these issues comprehensively, but urban planners in some nations have done a better job of preventing "urban sprawl" than others (e.g., Netherlands, Canada, Finland), and some nations have been more effective at preventing extremes of social inequality (e.g., Western European nations, South Korea). Indeed, the U.S. an outrageous negative example of both, having the most unequal distribution of wealth among industrial democracies. In comparative terms most American cities are "low density urban areas" exhibiting "urban sprawl," making many of the social forms noted above difficult or impossible (for example, widespread utilitarian bicycling, or the spatial integration of family and work). My own city in the American midwest (Omaha) has grown 60% in area in the last two decades, while its population has grown by only 12%, producing a sprawling comparatively low density urban area.

The emerging "global economy" about which much has been written, provides surprising and possibly hopeful observations. Both the American economy and the global economy (including much of the third world) are becoming economies of "elephants" and "ants," that is, economies of large oligopolistic firms that operate globally, which have received most publicity, but also economies of multitudes of small entrepreneurial firm, subcontractors, and independent "consultants." Small firms often in the "informal economy" have both bright and dark sides, including criminal activities and the micro-enterprises inspired by the Gameen Bank in Bangladesh. They collectively control an amazingly large share of economic assets in the U.S. - the global economy - but normally exist in political environments dominated by large oligopolies. Stimulating them, though fraught with problems, but has been viewed as a potential strategy to promote economic democracy, material sufficiency, and environmental sustainability (Aryes, 1996 : 11 - 23). They could empower small communities to sustainably manage some kinds of environmental resources.

6. A sustainable society would develop a culture of beliefs, values, and social paradigms that define and legitimize these natural, economic, and social

characteristics. The natural environments of human life would be understood more as ecological systems to be nourished and maintained than as open environments to be utilized and exploited at will. Dominant social paradigms that underlie belief and action would change appropriately. The virtues of material sufficiency and frugality would temper the "culture of consumerism"; materialism simply could not survive the transition to sustainable societies (Brown and others, 1990 : 190). Neither self worth nor social status would be measured primarily in terms of possessions, and much of the energy now devoted to accumulating and consuming goods could be directed at forming richer human relationships, stronger human communities, and greater outlets for artistic and cultural expression. Both Western style free-wheeling individualism and traditional communalism, would be tempered with a kind of communitarianism that balances individual human rights with obligations to community (Etzioni, 1993). Power and social restraints would continue, but truly sustainable societies would not be authoritarian. Tolerance of diversity, commitments to social justice and democratic politics are necessary to elicit the required responsiveness, cooperation, and coordination of people - both within and between societies. In terms of policy, such cultures could be promoted by education campaigns that have broad and diffuse impacts over time. On the bright side, public opinion polls find that people around the world are increasingly aware of the need to protect the environment, for their own well-being as well as other reasons (for a sophisticated study of attitudes among American samples see Olsen, Lodwick and Dunlap, 1992). Pro-environment attitudes have become pervasive but not yet particularly deep, and not always connected to understanding the connections between environmental protection and affluent consumption lifestyles. Affluent material consumption is undoubtedly the environmental "Achilles' heel" of American culture, rapidly spreading around the globe as international economy grows. The culture of affluence, promoted as it is by multi-billion dollar advertising and marketing industries will be most difficult to transform. Even so, the virtues of "voluntary simplicity" have supporters in both the industrial nations as well as among more traditional peoples around the world.

7. In a world where nations are connected with each other and to common pool resources, a sustainable society would cooperate in the negotiation of

sustainability in other societies - in terms of their different circumstances. In doing so it would participate in regional and international political regimes, treaties, regulatory agencies, and multinational governmental and non - governmental organizations. Such relationships would work to transform the emerging system of global investment and trade to promote sustainable development, rather than one of growing environmental disruption and inequity. They would promote the development of the both developed and less developed nations in a sustainable way. In a finite world, they would work to balance the requirements for some sort of global regulatory system with desires for national autonomy. There are many international agreements and treaties signed by now. Environmental ones attempt to regulate the human impacts on common pool resources and sinks whose importance is not confined to a single nation (like ocean fisheries or the earth's climate). Too numerous to mention here in detail, they are always incompletely successful for many reasons, but primarily because they impact the trade and economic activities of nations. Shortly before this conference, an important gathering of nations at Kyoto Japan attempted to negotiate an agreement limiting the human impacts on the changing world climate. In a finite world environment the long run stakes are very great that such international agreements work effectively.

After outlining these seven characteristics, I repeat that today's societies are not even close to being truly sustainable societies, in spite of efforts and some progress. Surely sustainability is relative, and change may evolve in small, incremental stages. But enough change to be effective would eventually produce dramatic social transformation on a large - scale - eventually on a global scale. These characteristics (however conceptualized) could become targets for community, regional, national, and global policy initiative aimed at moving nations and the world closer to sustainable development. Above I noted "community resource management" as a useful way of promoting such changes, to which I now turn in some depth.

Ⅳ. COMMUNITY RESOURCE MANAGEMENT

In Garrett Hardin's famous analysis the management of common pool environmental resources is disastrous because individuals (or individual firms) often cannot be

denied the use of such resources, but neither is there a way of making individuals accountable for the costs that they incur. His famous illustration is of the ruination of village pasture land held "in common," because no farmer could be restrained from putting as many grazing animals on it as he wished, but no one in particular tended to its maintenance. Hence overgrazing and the "tragedy of the commons," as a metaphor for degradation of the environment in general. Yet there are cases of successful community management of common resources (CRM), and I briefly note three of them.

In Torbel Switzerland, villagers have since the 14th century practiced rules to successfully manage fragile alpine meadowlands and forests, where cattle were grazed in the summer but not in winter. They decided that Alpine lands should belong to the community rather than to private owners, and established rules that so no one is permitted to graze more animals in the summer than he could feed in the winter, that cows were sent to Alpine meadows all at once and counted, and that trees for harvest were marked once a year by a community forester. To manage viable Alpine meadowlands, these rules stood the test of time, population growth, and employment outside the village area (Netting, 1976; 1981).

The Atlantic coast of New England (U.S.A.) is home to important fishing industries. Unlike many fishing grounds in the North Atlantic, lobster fisheries along the central coast of the state of Maine have been sustainably maintained for decades. Lobstering is done by fishers in small boats who drop small lobster traps (or "pots") into identifiable shoreline harbors, moving to deeper water in the winter. CRM is possible because the State limits the number, size, and sex of lobsters that can be harvested and requires lobstermen to get a license and display a license number prominently on the line connected to each particular pot. But most of the credit goes to Lobstermen themselves. In order to maintain their livelihood, communities of lobstermen developed strong, unwritten rules governing assigned territories that were defended against outsiders. A new fisherman must be accepted by a "harbor gang," and fish only in an assigned territories. Interlopers are sternly warned, and if they persist their equipment sabotaged. This CRM preserved lobsters and livelihoods of fishers for decades. Along other parts of the coast it became more difficult to defend well-defined territories, with the advent of motorized boats

and dep t h-finding equipment by lobstermen who could afford them. To do so, they had to "invade" many territories and fish far off - shore. Both established fishers and interlopers acted with restraint rather than start all out "war" with disastrous costs for all. Thus CRM worked even when and where control was much looser, the fisher and lobstermen have survived (Acheson, 1975, 1981; Gardner and Stern, 1996 : 127 - 28).

Several Turkish coastal fishing areas were threatened with overfishing in the 1970s. Fishers formed a local fishing cooperative that practiced CRM by assigning each fisher an area for harvest at the beginning of each fishing season, and afterwards fishers changed areas daily by prearranged rules. The plan worked in Alanya but not in all other villages. A key difference was the informal organization among fishers in successful villages, who not only knew each other well, but all met in a local coffee shop at the end of each working day, where news about who was catching what, whether the catch was declining and whether CRM rules should be modified. Established fishers could easily confront interlopers at the end of the day (Berkes, 1986; Gardner and Stern, 1996 : 131 - 32). Are these cases simply unusual exceptions to a universal about the "tragedy of the commons" No indeed.

1. Conditions for Successful CRM

Many such cases of successful CRM were analyzed by political scientist Elinor Ostrom, who focused on conditions related to success and failure (1990). She focused on the sustainablility of common pool resources that were important for livelihoods and geographically large enough to make it difficult but not impossible to exclude individuals from befitting from their use. Ostrom concluded that successful and sustainable CRM systems depend on the characteristics of (1) the resource, (2) the group using the resource, (3) the rules they develop, and (4) the actions of governments at regional and national levels. More detail about the first three of these are summarized Table 1.

Table 1 : Conditions of Conductive to Successful Community Resource Management

I. Resource is controllable locally
  1. Definable boundaries (land more than water, water more than air)
  2. Resources stay with boundaries(plants more than animals, lake fish more than ocean fish)
  3. Local CRM rules can be enforced (higher-level governments recognize local control and help enforce rules)
  4. Changes in resource can be adequately monitored

Ⅱ. Local resource dependence
  1. Perceptible threat of resource depletion
  2. Difficulty in finding substitutes for local resources
  3. Difficulty or expense attached to leaving area

Ⅲ. Presence of community
  1. Stable, usually small population
  2. Thick network of social interaction and relationships
  3. Shared norms ("social capital") especially norms for upholding agreements
  4. Resource users have enough "local knowledge" of the resource to devise fair and effective rules
  1. facilitates 2., and both facilitate 3. All make it easy to share information and resolve conflicts informally

Ⅳ. Appropriate Rules and Procedures
  1. Participatory selection and modification of rules
  2. The Group controls monitoring, enforcement, and personnel
  3. Rules emphasize exclusion of outsiders and the restraint of insiders
  4. Congruence of rules and resources
  5. Rules have built-in incentives for compliance
  6. Graduated, easy to administer penalties

Sources : adapted from Ostrom (1990); Gardner and Stern, (1996 : 130)

What about successful CRM and the "tragedy of the commons" Hardin assumes that the overriding human motives are always self-centered, and therefore that CRM institutions

must always fail. So he teaches that government coercion is the only way to avoid disaster. He is not alone in this way of thinkin; both behaviorist psychology and neo-classical economics view individuals as acting alone and rarely consider how social institutions can shape individual self interest. Recently economists began to address the question of institutions. It may make a great difference in addressing environmental and other human problems whether they are considered in individualistic self-interest terms or by creating social institutions and using social relationships (Gardner and Stern, 1996 : 136-37).

2. The social psychology of successful CRM

As Hardin convincingly demonstrates, the success of CRM depends on controlling the behavior of individuals. The cases noted above were all communities with "dense social networks" and cohesive cultural norms that could shape and restrain individual action. What makes individuals follow rules when they can gain something by breaking them? The key is that most people do what is good for the group (and the resource base) when they internalize the group's interest rather act from compliance with external costs or rewards. Such incentives work only when people expect to be punished, but internalization works all the time. When a CRM system is effective and most people internalize norms, penalties are rarely imposed and the costs to maintain the CRM system is low. Few break the rules, and when they do, mild sanctions are usually enough, making severe ones unnecessary. But without any incentives, some could take advantage of the self-restraint of others with impunity. The system's whole basis of trust would begin to unravel, increasing enforcement costs and ending in the tragedy of the commons. People are more likely to internalize group norms when they participate in creating them, when they value them for themselves and their community, and because they become a part of the very meaning of community that they share with others. Internalized self control is the ultimate basis for community control. Such informal social control can help manage environmental resources, control crime and address many other social problems, but they sometimes repress individual desires and may often be in tension with widely held modern values like individual freedom and procedural justice (Kelman, 1958; Gardner and Stern, 1996 : 135-36).

3. Beyond local communities : the role of central governments

Ostrom found that the success of CRM also depended on factors beyond local communities, particularly the support of local, regional, and national governments. But government may impede as well as facilitate CRM, particularly if officials accept bribes or political favors to allow some individuals to use more than their share. Such corruption is most likely where government officials have limited ties to local communities, and where local resource users do not have enough political power to exercise control over government officials. When they help, governments can provide local rules the status of legally enforceable contracts, and provide support for monitoring the resource in question. In the U.S. the State of California helped regional water users in both these ways. Water management institutions were "nested institutions," in which smaller private and municipal pumping and distribution agencies are nested in larger county and regional associations. They negotiated agreements to restrict pumping as an alternative to expensive law suits over water rights. The State helped with the costs of monitoring the agreements, and treated them as legally binding in state courts. Such comanagement is a promising new idea in CRM (McCay, 1993).

But in modern developed societies, few people are dependent on local resources like the fishers, wood cutters, and cattle grazers as in the cases noted above. Global markets insure that people with cash incomes can almost always escape the pain of local shortages and simply buy from elsewhere (Which is why the growing costliness of food is not often apparent to people in rich nations.). But even in modern societies people are usually dependent on local common-pool resources for water and solid waste disposal. I noted a water management CRM Southern California earlier, a region notorious for aquifer overdrafts, periodic droughts, and changing water availability. Similarly, on America's dry great plains region where I live water was historically mismanaged by diversion of reservoir and river water as well as pumping from the large Ogallah aquifer. CRM is not as successful as in Southern California, but water use produces a continual source of political squabbles, negotiation, and litigation between states, communities, and

use sectors (e.g., agricultural, industrial, municipal).

The waste products of modern societies are almost always disposed of locally. While disposal in running water or the air carry wastes out of communities, weakening support for CRM, solid wastes are almost always disposed locally, in landfills. Almost every U.S. city or large municipality is experimenting with schemes to conserve landfill space, and community-based waste separating and recycling programs-with varying degrees of success. The U.S. has not progressed as far as most West European nations in this regard.

Even where there is not clear local resource dependency, CRM programs have shown promise. Although few U.S. communities depend on local resource for their energy supplies, a number of them have successfully operated CRM energy programs (e.g., Fitchberg, Massachsetts, and various Minnesota communities, instigated by the state Residential Conservation Service Program). Such programs made energy monitoring and efficiency measures easy to practice, and, as in the above cases, worked mainly by face-to-face communication among people already connected in communities with some degree of trust, and activated personal values about environmental protection (Gardner and Stern, 1996 : 139-143).

4. CRM and social trends

Modernization and development processes around the world stimulated large-scale economic and political systems, and rapidly transformed of subsistence economies into market economies driven by commodity exchange. These trends had many negative environmental consequences. There are many reasons for this, but one is that the development process often disrupts local CRM, and in this sense, CRM is contrary to powerful social forces of the 20th century. In fact, these social forces have been weakening two of the major conditions in Table 1 : local resource dependence and the presence of dense, stable community networks. Family farms and ranches in the U.S., owned by individual proprietors interested in sustainable management (and leaving productive land to their children), have been being displaced by agribusiness "corporate farms" owned by remote investors who have

little interest in sustaining productivity beyond the "natural life" of the capital invested (about 10 years). Another illustration comes from the foothills of the Indian Himalayas, where for centuries people locally managed and relied on the forest for cooking fuel, fodder, and food. Forests also helped control the floods that sweep through the region every monsoon season. In the 1950s, commercial lumbering entered the regions, felling the forests. When reforested, at the urging of a central government agency, the result was a monoculture of rapidly growing Eucalyptus trees, that produce lumber but no fruit, little fodder, or mushrooms, and few twigs for fuel. By the 1960s floods in the lower Ganges basin became increasingly serious. The reaction was not long in coming, and it came not from the lumber companies or official of the central government, but as a popular protest movement (the "chipko" movement) initial mobilized by women with experience in Gandhi's non-violent resistance to British rule. They surrounded and literally hugged trees, staying in place until scheduled tree harvest was postponed or canceled. The movement drew on deeply held spiritual and community values, as well as survival needs (see Shiva, 1989 : 74 - 75). Gardner and Stern draw two lessons from the Chipko movement : (1) commercial development does not "privatize" the commons so much as it shifts community resource control to outside agents, and (2) CRM can sometimes yield social, environmental, and even economic benefits far exceeding commercial commodification that experts and central government officials recognize (1996 : 145). Reactions to the intrusions of corporate agriculture into the historic systems of family farms are similarly visible in the U.S.. Popular movements attempt to protect private farmers lobbied farm state legislatures to make it illegal for absentee owned corporations to own or operate farms and ranches (My state of Nebraska has had such a law for about 10 years now.). The final chapter of the political interactions between this movement in relation to the political influence of large agribusiness firms is still uncertain. To make CRM practical among larger entities than local communities, a number of policy thinkers advocated reorganizing societies and economies so that regional boundaries match ecological ones (e.g., watersheds, ecosystems), rather than accidents of political history, an organizing principle termed bioregionalism (Sale, 1991).

5. Advantages, limitations, and the promise of CRM

Gardner and Sterm list 6 advantages and 2 limitations of the practice of CRM, which I list summarily. The advantages are that CRM

1. builds on long-standing social traditions,
2. can internalize externalities,
3. can be effective over very long time periods,
4. can encourage people to move beyond egoism or selfishness,
5. has low enforcement costs,
6. is often the "forgotten" strategy.

But CRM is limited because

1. It works best with a limited range of resource types,
2. Social trends often destroy the basis for its successful practice (1996 : 149-150).

The limitations are serious indeed. They mean that major world environmental problems are not amenable to CRM, and that fewer communities have the necessary skills for practicing CRM. I am less convinced by the last limitation that the first one. That is because in my reading of social theory about postmodernism, globalization and so forth, observers note seemingly paradoxial (dialectical?) trends going on. Trends toward bigness, growth in scale, and commodification of social relations need no comment. But observers also note the pervasive and seemingly paradoxical revival and/or reconstituion of local relations, sometimes fraught with negative consequences (the growth of civil wars), but also with positive possibilities (growing influence of NGOs, and micro-enterprises that I noted earlier). As one theorist argued, the dominant trend is not globalization, but glocalization (Featherstone, 1990; Giddens, 1990; Robertson 1990; and Meyrowitz, 1997). That at least is cause for hope. Despite limitations, CRM, or at least its principles, has great promise for dealing with certain environmental problems as part of a mix of strategies for dealing with them. It could perhaps, give new operational meaning to the mantra of the environmental movement : "Think globally but act locally."

V. RECENT DEVELOPMENTS IN MEASURING AND INTERPRETING THE HUMAN ENVIRONMENTAL IMPACT

In the 1970s, Biologist Paul Ehrlich and energy scientist John Holdren created a now standard way of conceptualizing the joint impact of the human causes of environmental change (Holdren and Ehrlich, 1974; Ehrlich and Ehrlich, 1992). They argued that the impact of any population or nation upon environmental and ecosystems a product of its population (P), its level of affluence (A), and the damage done by particular technologies (T) that support that affluence :

$$I = P \times A \times T$$

This is a simple but elegant way of illustrating different but related dimensions of environmental impact as functions of the number of people, the technologies they employ to produce goods, and the amount of goods they consume. While the relative weights of these are subject to debate, it is methodologically useful for scholars because it is possible to develop quantitative summary measures for each term of the formula (Dunlap, 1995 464)[5] Since each term multiplies independently, it follows that the opportunities for changing them are different in different societies. Developing nations have, for example, the most room from improvement in P; the more developed nations have the greatest potential for improvement in A and T.

1. Affluence, Social Inequality, and Environmental Impacts

Not surprisingly, social scientists have been most interested and competent to deal with A of the $I = P \times T$ equation. They have suggested that affluence by

5) For population, size and growth rates are obvious indicators; for affluence, measures of the per capita gross national product, or per capita consumption of selected goods (copper, meat, steel, timber, autos, plastics, aluminum) are relevant; for technology, the per capita Kwh of electricity, or some other energy measures of economy productivity. These are suggestive but obviously simplistic.

itself oversimplifies the social dimension of environmental problems (Dunlap, 1992). It does so because affluence is one end of a broader continuum of social inequality generated by social processes everywhere. It becomes increasingly clear that not just affluence, but affluence and poverty as ends on a continuum of social inequality - both within and between nations - are prime causes of environmental disruption. If affluence is an environmental problem, poverty may be as bad. How so? First, an empirical observation.

Social inequality has been growing slowly but steadily since the 1970s, both in the developing and developed worlds. It grew both within and between societies. Such growth of social inequality means a growth of both affluence and poverty at the same time. In the developed nations, social inequality declined after World War II until about the mid 1970s, after which it has steadily but slowly increased. In the U.S., from 1973 to 1993, the "share" of national incomes accounted for by the top 5% of earners increased by 20%, while the "shares" of the middle 60% shrank by 12%., and those of the lowest 20% of earners saw their measly shares shrink by another 25% (Stockhausen, 1995 : 13; Dolbeare and Hubbell, 1996 : 38). The same trends are observable in West European nations, though the social consequences are often masked by more generous state social benefits. The distribution of wealth (vs disposable income) was becoming even more skewed. While noticeable in most developed nations (e.g., Canada, Germany, France, Netherlands) it was again more extreme in the U.S. In fact, by 1990 the distribution of wealth (not income) in the U.S. more closely resembled that of the Philippines, India, and Venezuela than that of Germany, the United Kingdom, or Canada (Sivard, 1993; Durning, 1990 : 138) !

The growth of global inequality stands out in even sharper relief between nations. In 1960 the richest 20% of the word's people absorbed 70% of global income; by 1989 the share of the wealthy had increased to nearly 83%. The poorest 20%, meanwhile, saw their share of global income drop from a meager 2.3% to a more meager 1.4%. The ratio of the richest fifth's share to the poorest's thus grew from 30 to 1 in 1960 to 59 to 1 in 1989 (Postel, 1994 : 5). Both within and between

nations, the chasm between the rich and the not so rich is growing (see Table 2).

Table 2 : Global Income Distribution, 1960 - 1989

	Share of Global Income Going to the :		
Year	Richest 20%	Poorest 20%	Ratio : Richest to Poorest
1960	70.2%	2.3%	30 to 1
1970	73.9	2.3	32 to 1
1980	76.3	1.7	45 to 1
1989	82.7	1.4	59 to 1

Source : United Nations Development Programme, Human Development Report 1992. New York : Oxford University Press, 1992.

The causes of growing social inequality are complex, but in general have to do with (1) the increasing shift of less skilled labor to low wage developing nations, and (2) the technological up-grading of production which reduces the total demand for less skilled labor. Inequality has been growing even as the world economic output has increased, and the world market system has become more integrated. The social consequences of this process are profound. At minimum it is likely to increase social polarization and political tensions both within and between nations.

2. Inequality and Environmental Degradation

Part of the reason that inequality increases social tensions is that environmental degradation impacts the living standards and lifestyles of different social classes and ethnic groups in different ways. Affluent classes are to be able to respond to environmental problems with minimal consequences for modifying their lifestyles. They are, for instance, best able to afford higher prices or energy taxes, and to purchase more efficient homes, autos, or appliances. The less affluent classes are less able to do so. An enormous body of research demonstrates that both lower socioeconomic classes and racial minorities bear more than their share of

the costs of environmental problems and change. They live in zones more threatened by toxic wastes of all kinds, and landfills and waste repositories are more likely to be built in the neighborhoods and communities where they live. Both inter and intra - national "trade" in garbage means that wealthier people are likely to send their garbage to the neighborhoods and nations of the poor (Bullard, 1990; 1993; Bryant and Mohai, 1992; Schnaiberg and Gould, 1993 : 153; Dillman and others, 1983; Lutzenhiser and Hackett, 1993). But growing inequality is itself a potent cause of environmental degradation.

Again, growing evidence indicates that people at either end of the income spectrum are far more likely than those in the middle to damage the earth's ecological health - the rich because their affluent lifestyles are likely to lead them to consume an overproportionate share of the earth's food, energy, raw materials, manufactured goods, and the poor because their poverty drives them to damage and abuse the environment. The poorer classes in more developed nations damage the environment not because they consume so much, but because they are able to afford only older, cheaper, less durable, less efficient, and more environmentally damaging products - autos, appliances, homes, and so forth. In other words, the affluent - who can afford the newest and most efficient of everything - damage the environment because of the volume of energy and material they consume. The poor do so because whatever they consume is likely to have a greater per unit environmental impact. It is important to note that it is not the poorest among the poor - who have no autos, apartments, or appliances of any kind - who are environmentally most damaging. It is rather the most marginal segment of unskilled workers who still have sufficient amenities to have an impact on the environment, rather than, for instance, the transient or homeless who have virtually nothing.

In less developed nations, population pressures and very inequitable income distribution pushes many of the poor onto fragile lands, where they overexploit local resource bases, sacrificing the future to salvage the present. Short - term strategies such as slash - and - burn agriculture, abbreviated fallow periods, harvests exceeding regeneration rates, depletion of topsoil, and deforestation permit survival

in the present but place enormous burden upon future generations (Goodland and others, 1993 : 7). In fact, with uncanny regularity, the world's most impoverished regions also suffer the worst ecological damage; maps of the two are almost interchangeable. In China, India, Pakistan, and Afghanistan, for instance, the impoverished live in degraded semiarid and arid regions or in the crowded hill country surrounding the Himalayas; Chinese poverty is particularly concentrated on the loess Plateau, where soil is eroding on a legendary scale (Durning, 1989 : 45).

Often the environmentally destructive behavior of the world's poor has to do with highly skewed landownership patterns. Rural small landholders whose land tenure is secure rarely overburden their land, even if they are poor. But dispossessed and insecure rural households often have no choice but to do so. Neither hired workers, hired managers, nor tenant farmers care for land as well as owners do (a principle that works also in the U.S. !). Being landless is in fact a common condition among rural households in many LDCs : 40% of Africans, 53% of Indians, 60% of Filipinos, 75% of Ecuadorians, 70% of Brazilians, and 92% in of rural households in the Dominican Republic are landless or near landless (Durning, 1990 : 142). While such poverty impacts the environment, the causality here is not one way. Even before it is degraded, a marginal area by nature does not usually produce enough surplus to lift its inhabitants out of poverty. Poor areas and poor people destroy each other. Furthermore, as in the MDCs, it is not the poorest of the poor, who have no consumer amenities or access to land whatsoever, who are the greatest problem. The poorest of the poor, whether in rural areas or urban shantytowns are most likely to be widows, divorcees, and single mothers. They consume less and produce less waste per capita than all others. They probably tread lightest of all upon the earth, and do less damage to the environment than any other groups. They are victims, not perpetrators (Harrison, 1993 : 260). A reformed land tenure system which gives secure ownership of land, even in small parcels, to the landless peasants of the world would go some distance toward moderating the high birth rates and staunching the destruction of ecosystems by the world's poor.

The affluent populations of the developed world also threaten the global ecosystem, but not because they are desperate with few alternatives. It is their consumerist culture, purchasing power, and economic arrangements to support lifestyles that consume an overproportionate share of the world's resources. With about 20% of the world's population, they consume 10 times the energy as their counterparts in LDCs, 10 times the timber, 13 times the iron and steel, 14 times the paper, 18 times the synthetic chemicals, and 19 times the aluminum. They account for a disproportionate share of resource depletion, environmental pollution, and habitat degradation that humans have cause worldwide. A world full of affluent societies that consume at such levels is an ecological impossibility (Durning, 1994 : 12).

In sum poverty and affluence are both threats to the environment, and becoming more so as the chasm of social inequality widens around the world. A reduction of social inequality within and between nations would reduce pressure on the environment, both through reducing the resource consumption of the affluent and by reducing the need to overharvest, overgraze, or overfish to meet the short - run subsistence needs of the poor.

3. I = P A T in research

In empirical research the I = PAT normally understood as an "accounting" or difference equation, where values for three of the four terms are used to "solve" for the fourth (usually T), and in which the relative impacts of P, A, and T on I are determined by their changes over time. But that assumes the model is linear and the effects of the different terms are proportional. Research by Dietz and Rosa (1994a) reformulates I = PAT as a "stochastc" model, in which values of the terms of the equation were allowed to vary across observational units (nations). Their reformulation is also sensitive to possible non - proportional "threshold effects" that identify diminishing or increasing impacts of the terms of the equation in relation to environmental impact (I). Specifically, they used non - linear regression formulas and other multivariate statistical techniques to study the

contributions of population, affluence, and technology on the production of greenhouse gasses in various nations. They used existing data from 111 nations about CO2 emissions (in millions of metric tone of carbon per year), population (population size), affluence (gross domestic product per capita). Technology was not measured directly, but rather modeled as a "residual term," that is, as a multiplier in the equations to capture all things (physical infrastructure, social and economic organization, culture, and so forth) whose effects are not captured by population and affluence.

Their findings demonstrate the significant utility of the I = PAT model, and I discuss them here in some depth. They found that increasing population among nations increased CO2 production, and did so in a linear way without any "threshold effects" : the more people, the more CO2. They argue that these finding embarrass the argument made by some neoclassical economists and Julian Simon (1981) in particular that "population has little effect or even a beneficial effect on the environment." They lend support to ongoing concern with population growth as a driving force of environmental impacts (Dietz and Rosa, 1994a : 6). By contrast they found that the effects of affluence on CO2 emissions level off and even decline somewhat at the very highest levels of gross domestic product per capita. They suggest that this derives from the shift from manufacturing to service economies, and from the ability of more affluent economies to invest in energy efficiency. Unfortunately, they found that this effect occurs at affluence levels above 75% of the 111 nations in the sample, and that for the overwhelming majority of nations, continued economic growth can be expected to produce increasing, rather than declining CO2 emissions. In other words, reductions in CO2 emissions will not occur in the normal course of development, and will have to come from targeted efforts to shift towards less carbon intensive technologies (Dietz and Rosa, 1994a : 7).

They use the "technology multipliers" to identify some nations for particular analysis because they have multipliers different than one would expect at particular levels of affluence and population size. Of particular interest were nations with unusually large multipliers - meaning that they emit far more CO2 than would be expected from their population size and level of affluence. These include Bulgaria,

Zimbabwe, and Poland. In contrast other nations had relatively small multipliers and small CO2 emissions for their size and levels of affluence. These included France, Spain, and Brazil. The authors hypothesize about particular "technology - infrastructure" differences that would account for such anomalies. Bulgaria and Poland, as former Soviet bloc nations, consumed a lot of fossil fuels relative to their levels of affluence, while Zimbabwe has a large industrial sector relative to its level of affluence, and is also a fossil fuel producer. Similar factors explain the nations with lower levels of CO2 production than would be expected at given levels of size and affluence : France's extensive reliance on nuclear power, Spain's use of nuclear and hydroelectric power and its relatively low level of automobile ownership, Brazil's reliance on hydroelectric and liquid natural gas fuels (Dietz and Rosa, 1994a : 9). Finally, Dietz and Rosa estimated the coefficients of their statistical model to project global CO2 emissions for the year 2025, using various U.N. projections for population and economic growth. They concluded that to achieve a goal of stable emissions at 1991 levels in the face of economic and population growth, energy efficiency gains of 1.8% per year would need to average from 1990 to 1025. The researchers believe that "these increases are feasible, but will not occur without strenuous efforts" (Dietz and Rosa, 1994a : 9).

4. I = PAe?

Upon reflection, one of the authors of these papers, Thomas Dietz, argued for replacing T with e, when used as they did, to model "everything else" in the sociocultural world as the residual term in regression equations. T makes one think only of technology and the "hardware" infrastructure. Culture certainly includes the technical infrastructure of economic production, but it is broader than that, including political organization, laws, regulations and enforcement, waste disposal and tastes that lead to consumer choices … and so on (Dietz, 1996/1997 : 168). The point is that society (or culture) is the important mediator between population and environment. This leads him to five interpretive points which he admits are arguable but useful in most policy contexts :

1. *The amount of growth does not matter nearly as much as the speed with which it takes place.* A human ecosystem may be able to sustain a large population, but rapid growth provides little time for adaptation. Thus the population problems is not only how many people, but how fast we add people. This echoes Cohen's point (noted earlier) that the "carrying capacity" is not a very helpful concept; transitions rather than the equilibrium state are what matters. For rare studies that focuses on the rate of growth, see Frey and Mansour (1995) and McNicoll (1984). This leads to two further points.

2. *migration may be more important than fertility.* Under conditions of turbulent economic and sociopolitical conditions, migration can produce changes that vary by an order of magnitude. When the rate of migration is very high, it is hard for hybrids and accommodations to evolve, and clashes and institutional problems are likely. Dietz cautions that this is not necessarily a justification for strict immigration policy, but rather that growth by migration provides problems (and opportunities) different from growth by fertility.

3. *It may be more important to look for the effects of rapid growth on social organization than on the environment per se.* The reason that studies of the population - environment relationship has produced so many contradictory and ambiguous findings is that growth always has a spatial and temporal aspect, and also on how different societies and cultures accommodate growth. Rapid growth can be very disruptive because it disrupts social organization - what Amin (1977) referred to as disarticulation - which can be the real cause of environmental degradation. Dietz enters two qualifications (1) it is not just population growth that transforms or disrupts sociocultural systems, and (2) it is important not to romanticize existing systems. Many changes in culture can be for the better, and "indeed, I would argue that it is the active efforts by social movements to produce cultural changes that are essential in producing new adaptive strategies for humans (Dietz, 1996/1997 : 169 - 70; see Brule, 1994).

4. *It is PA e that matters, not growth in P alone.* It is useful to think of "biospheric - equivalent persons," that accounts for per capita I rather than just numbers of

persons (B.E.P. = Ae/P). One therefore concludes that while India will have much more population growth than the U.S., each American baby will consume exponentially more. There is, therefore, a very serious population problem in the U.S., even at a lower growth rate, than in India. If we are worried about greenhouse emissions, pollution, or food consumption, we should worry more about the U.S., not the Indian population.

5. *Policy leverage exists in two areas: in slowing growth, and in changing e to accommodate the growth that will occur.*

Ⅵ. CONCLUSION : A TRANSFORMATION TO SUSTAINABILITY?

In an extraordinarily short period - a matter of decades - we will need to feed, house, nurture, educate, and employ at least as many more people as already live on the earth. If in such a warmer, more crowded world, if environmental catastrophe is to be avoided, it can be done only by (1) maintaining severe inequalities in human welfare, or (2) adopting very different trajectories for human development (Kates, 1994 : 118). Sustainable societies must emerge to avoid the kinds of organizational and environmental crises that would destroy society itself. And this implies major sociocultural transformations, within and between the world's nations.

Is a world transformation on this scale possible? Quite simply, yes. Is it probable? Who knows? Educated guesses vary widely. There are, in fact, examples of such massive and purposive social transformations. In the 19th century, Feudalism was abandoned in Japan, as was slavery was around the world. This century saw the retreat of imperialism and the creation of a United Europe. War provides obvious examples. Given the belief that national survival was at stake during World War II, the many populations mobilized and transformed themselves remarkable ways. Also impressive was the American Marshall Plan for reconstructing Europe after the war, and in 1947 the U.S. spent nearly 3% of its GNP on this huge set of

projects (Ruckelshaus, 1990 : 131 - 32). In more contemporary times the Soviet system collapsed, largely through the action of agents internal to the system. The People's Republic of China, after 40 years of relative (Maoist) stagnation, became the most buoyantly growing economy of the late 20th century, outstripping the buoyant period of Japanese growth in the 1960s. Most remarkably, by 1993 the Union of South Africa, had transformed itself peacefully and democratically from an outrageously brutal and authoritarian racial caste system to a multi-party and multi - ethnic society with a black man as the popularly elected prime minister. None of changes turned out exactly "as intended" or brought a problem - free social world into being. They only demonstrate that transformations on the scale required are possible.

Let me close by again citing Thomas Dietz at length, who ends on a hopeful note, as do I :

> The impacts of population and affluence on the environment are largely determined by culture [or institutional arrangements, if you prefer]. P and A must be multiplied by e to produce impacts. Inevitable growth in the coming decades can be mitigated by making the proper cultural, institutional, and organizational changes. This will not be easy. We do not know the proper changes to make and must experiment and learn as we go. Resistance to change will be substantial for ideological reasons and for reasons of power and profit. In addition, the growth itself will make rational adaptive change more difficult. But change is possible. Human culture is flexible and can be changed quickly in response to our best analyses and intentions (1996/1997 : 170).

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