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THE URGENT NEED FOR A RAPID TRANSITION TO GLOBAL ENVIRONMENTAL SUSTAINABILITY

Robert Goodland
Environment Department
The World Bank
Washington DC 20433 USA
Fax: 202/477-0565

NOTE: This paper should not be construed as representing the official views of any institution whatsoever.

PART I: THE CONCEPT OF ENVIRONMENTAL SUSTAINABILITY

". . . . When vital environmental issues, planetary life-support systems, have to be classed as externalities, it is time to restructure basic concepts. . . .".
Herman Daly

1. Introduction

Brundtland's call for sustainability has elicited two opposing reactions. One is to revert to a definition of sustainability as "growth as usual", although at a slower rate. The other reaction is to define sustainable development as "development without growth in throughput beyond environmental capacity." WCED leaders (Brundtland 1989, McNeill 1990) seem themselves to be torn between these two directions for operationalizing their concept.

The 1992 Reconvened Brundtland Commission has reconsidered its 1987 conclusion that sustainability could be achieved with "five to ten times more growth". In 1992, the Commission mentions growth neither where it is much needed (the poorest countries), nor where it is not at all needed (the rich countries). In other words, it seems that for the Brundtland Commission, growth has ceased to be consistent with sustainability. The Commission rightly ranks population as their first and second priorities, with full internalization of environmental costs as their third. Canada's position and Brundtland Reconvened seems to be a far more prudent guide for the world's life support systems than the skeptics cited in Annex 1.

Environmental sustainability is a widely espoused goal, largely thanks to the Brundtland Commission (1987), UNCED's Earth Summit (1992) and Canada's (1992) position. Environmental sustainability (ES) means maintaining global life-support systems. Specifically, maintaining environmental sink capacities to assimilate wastes, and maintaining environmental source capacities to regenerate raw materials, such as healthy air. Therefore, ES means keeping both the throughput of raw materials and energy within the regenerative and assimilative capacities of environmental sources and sinks.

The world is hurtling away from environmental sustainability at present (Simonis 1990; Meadows et al. 1992). The global society is being maintained only through the exhaustion and dispersion of a one-time inheritance of natural capital, such as topsoil, groundwater, tropical forest, fisheries, and biodiversity. The rapid depletion of these essential resources, coupled with the degradation of land and atmospheric quality show that the human economy has not only exceeded its current social carrying capacity, [1] but is actually reducing future potential biophysical carrying capacities by depleting essential

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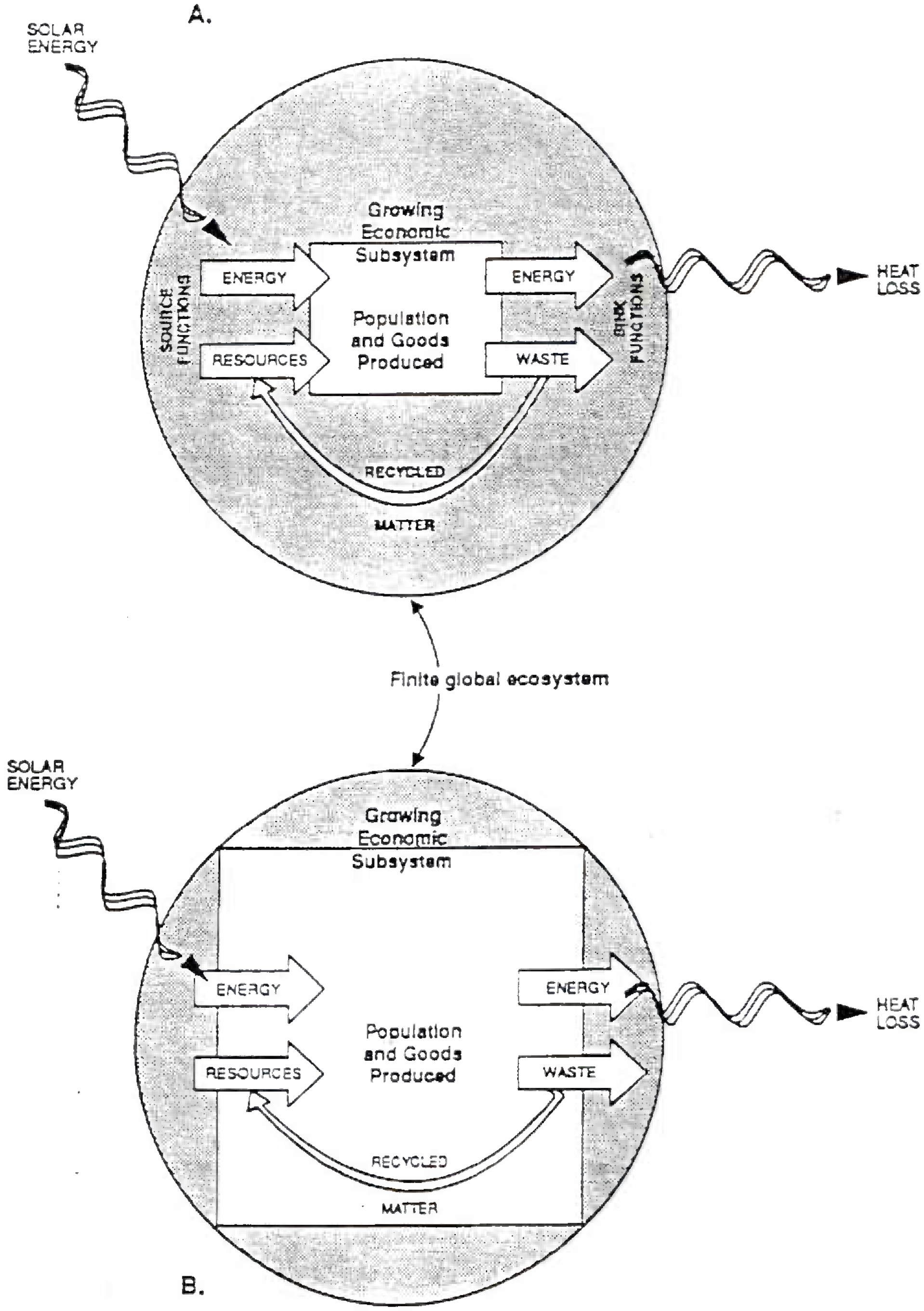
[1] Carrying capacity is a measure of the amount of renewable resources in the environment in units of the number of organisms these resources can support. It is thus a function of the area and the organism: a given area could support more lizards than birds with the same body mass. Carrying capacity is difficult to estimate for humans because of major differences in affluence and technology. An undesirable "factory-farm" approach could support a large human population at the lowest standards of living: certainly the maximum number of people is not the optimum. The higher the standard of living,

Figure 1: The finite global ecosystem relative to the growing economic subsystem



In the top diagram, the long gone "empty world" case, the scale of the human economic subsystem is small relative to the large, but non-growing global ecosystem. In the lower diagram, the "full world" case, the scale of the human economic subsystem is large and still growing, relative to the finite global ecosystem. In the full world case, the economic subsystem has already started to interfere with global ecosystemic processes, such as altering the composition of the atmosphere (Green house warming), or the now nearly global damage to the ozone shield.

cooking and heating fuels in developing countries (fuelwood). The human economic subsystem now appropriates more than half of all that energy. It is probably impossible, and certainly undesirable, to use the 100% that is implied in a single doubling of the human population. This suggests that we have much less than the 35-40 years left for the world to become sustainable[2]. Government policy should cherish their citizens, not cheapen them by encouraging breeding. Capitalists love cheap labor brought on by overpopulation and poverty, and if there is not enough available domestically they can move capital abroad or promote free immigration at home.

3.2 Affluence

Overconsumption by the North contributes more to the lack of environmental sustainability today than does population growth in the South (Mies 1991; Parikh & Parikh 1991). Using energy consumption as a surrogate for environmental sustainability or impact on the earth's life support systems: "A baby born in the United States represents twice the disaster for Earth as one born in Sweden, three times one born in Italy, 13 times one born in Brazil, 35 times one in India, 140 times one born in Bangladesh or Kenya, and 280 times one born in Chad, Rwanda, Haiti or Nepal" (Ehrlich & Ehrlich 1989). The key question is: can humans lower their per-capita impact at a rate sufficiently high to counterbalance their explosive increases in population?

Modifying Northern overconsumption conflicts with the orthodox economic "Trickle Down" view (Summers, 1991) that the North must consume even more in order to provide markets for Southern commodities (Goodland and Daly 1992). In addition, the affluent are reluctant to shift to the concept of sufficiency, quality and non-material satisfactions. Redistribution from rich to poor on any significant scale is felt to be politically impossible.

3.3 Technology

There is much misplaced technological optimism. New technology is often adopted in order to improve productivity, which in turn can raise material standard of living. The impact of a particular technology depends on the nature of the technology, the size of the population deploying it, and the population's level of affluence.

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[2] Several factors are all working in the same direction to reduce irreversibly the energy available globally through plants. Greenhouse warming and less predictable, unstable climates seem inescapable and may have started. These will reduce agricultural, forest, fisheries, rangeland and other yields. The increases in UVb light reaching the earth through the damaged ozone damaged may decrease the carbon-fixing rates of marine plankton, one of the biggest current carbon sinks. In addition, the UVb may damage young or germinating crops. Tiny temperature elevations have already begun to increase the decomposition rates of the vast global deposits of peats, soil organic matter, and muskeg, thus releasing stored carbon. Only in mid-1992 did the circumboreal muskeg and tundra become net global carbon sources (instead of being net C-sinks). George Woodwell calculates that at least an immediate 50% reduction in global fossil fuel use is necessary to stabilize atmospheric composition.

The two opposing reactions to environmental sustainability conflict. One is to revert to a definition of sustainable development as "growth as usual", although at a slower rate (Brundtland 1987, McNeill 1991, Bartelmus 1992). The other reaction is to define sustainable development as "development without growth in throughput beyond environmental carrying capacity."

Two realisms conflict. On the one hand, political realism rules out income redistribution and population stability as politically difficult, if not impossible; therefore the world economy has to expand "...by a factor of five or ten..." in order to cure poverty. On the other hand, ecological realism accepts that the global economy has already exceeded the sustainable limits of the global ecosystem and that a five to tenfold expansion of anything remotely resembling the present economy would simply speed us from today's long run unsustainability to imminent collapse. We believe that in conflicts between biophysical realities and political realities, the latter must eventually give ground. The planet will transit to sustainability: the choice is between society planning for an orderly transition, or letting physical limits and environmental damage dictate the timing and course of the transition.

Figure 2: Priorities to Approach Environmental Sustainability

a) Accelerate the transition to population stability.

b) Accelerate the transition to renewable energy.

c) Human capital formation: education and training, employment creation, particularly for girls equivalent to that for boys.

d) Technological transfer: for the South and East to leapfrog the North's environmentally damaging stage of economic evolution; job creation rather than automation.

e) Direct poverty alleviation: including social safety nets, and targeted aid.

While we agree with Brundtland that we should seek to limit, arrest, or even reduce the throughput associated with economic activity, we are far less sanguine about our ability to achieve this quickly. The vast expansion in economic activity projected by Brundtland is therefore bound to be associated major rises in throughput. This does not involve any difference in theory between Brundtland and ourselves, but merely reflects the observable fact that successful substitution of manmade capital for natural resources is slow and limited, and that the necessary technology cannot be organized on cue as the optimists would wish.

Political will is the scarcest resource. It is very difficult to face up to the need for income redistribution and population stability. If the concept of sustainable development becomes a verbal formula for glossing over these harsh realities, then it will have been a big step backwards . It is in this sense that we are seeking to build on Brundtland before the tempest of conventional political "realisms" erodes the foundations that WCED constructed with such care and foresight. Such an agenda will be exceptionally difficult to implement, and many other issues are involved which are not here addressed, but of which we are acutely aware.[7] Markets, for example, will have to learn to function without expansion, without wars, without wastes, and without advertising that encourages waste. Economic policy will have to suppress certain activities in order to allow others to expand, so that the sum total remains within the biophysical budget constraint of a nongrowing throughput. This adds up to a formidable political agenda. That is why exceptional political wisdom and leadership are so urgently required.

5. Natural Capital is Now Limiting

In an era in which natural capital was considered finite relative to the scale of human use, it was reasonable not to deduct natural capital consumption from gross receipts in calculating income. That era is now past. Today the limiting factor in development is more often remaining natural capital than extra manmade capital. Fish catch is limited by remaining fish population, not by fishing boats; timber is limited by remaining forests, not by saw mills; petroleum is limited by geological deposits and atmospheric capacity to absorb CO_2 not by refining capacity.

The goal of environmental sustainability is the conservative effort to maintain the traditional meaning and measure of income in an era in which natural capital is not longer a free good, but is more and more the limiting factor in development. At a conceptual level the justification for making environmental sustainability a sine qua non for project eligibility could not be stronger or more conservative. The difficulties in applying the concept arise mainly from operational problems of measurement and valuation of natural capital.

[7] Reapa di Meana, EC's Environmental Commissioner, refrained from participating in the June 1992 "Earth Summit" because of opposition to the much needed carbon or non-renewable energy tax. The transition to renewable energy was taken off the agenda, largely at the behest of the oil lobby. Population stability was scarcely addressed. The UN's Center for Transnational Corporations was abolished, and replaced by the business sector's own voluntary code.

PART 2: PRACTICAL MEANS TO APPROACH ENVIRONMENTAL SUSTAINABILITY

1. Introduction

We outline four main means to approach environmental sustainability: first, sound economics; second, environmental accounting; third, environmental assessment; and fourth, use of operational guidelines. The first and probably easiest step to approach towards environmental sustainability would be to start on the microeconomic side by using sound economics, or as Summers (1992) implies: improved environmental cost/benefit analysis (CB). The second on the macroeconomic side is to recognize the liquidation of natural capital resources by means of environmental accounting. The third is to use environmental assessment as a relatively easy means to improve CB analysis and to incorporate environmental costs into project appraisal. The fourth, and as a safety net, is to follow rough guidelines for sustainability. These form the four elements of the approach to sustainability.

2. Sound Economics for Environmental Sustainability

Since the use of sound economics is espoused by all (although not at all commonly applied, as recognized by Summers 1992), what we mean by sound economics is only outlined. We believe that both sound economics and environmental assessment are necessary, but not sufficient conditions to reach environmental sustainability on the microeconomic side. This needs to be complemented on the macroeconomic side with environmental accounting.

The main reason economics has been slow to internalize environmental externalities and incorporate environmental considerations in economic analysis, is that economics deals with scarcities, and until relatively recently many environmental goods were not scarce. Scarcity value is the trigger for economics to address concerns. Most environmental scarcity phenomena are recent. Environmental goods such as clean air, clean water, intact ozone shield, greenhouse-free atmosphere, and intact biodiversity became scarce at different times, but mostly relatively recently. Now many environmental goods and services are suffering increasing, strongly negative, and pervasive assaults.

The second reason economics has been slow to internalize environmental functions is that even when scarce, many cannot be traded in markets and therefore are unpriced. Current economics works effectively with marketable goods, but inefficiently or not at all with non-marketed goods. Even so, we claim that the easiest of the steps towards sustainability is merely to apply sound economics. We urge the use of sound economics as soon as possible because of the exponential nature of much global environmental deterioration, and the possibility of surprise: non-linearity and overshoot. Humanity tends to be poor at perceiving slow-moving but dangerous trends. Their gradual start should not lead to complacency.

By "sound economics" we mean measures to mitigate today's three massive failures: information "failure", market "failure", and policy "failure", the combined effect of which has been to over-use and

3. Third, to the extent possible, include non-monetary values in project justification. Cost-benefit analysis should be rigorously applied to capture just as much as it possibly can. But where it cannot, and the areas are major, then qualitative assessment should be accorded adequate weight. Examples include cases where an environmental value cannot be quantified, such as conservation of biodiversity, or where a sustainability criterion cannot be quantified (see below).

4. Fourth and last cluster can be called the transparency principle (Annex 1). Markets can function efficiently only if relevant information is available at low cost. Therefore, all environmentally-damaging activities of public and private enterprise should be revealed. When voters, communities and consumers know who is damaging the environment and who is not, there will be fast progress towards environmental prudence, even if formal regulation lags. Similarly, the assumptions on which economic decisions are based must be divulged. For example, the assumptions behind rates of return analyses are rarely available. The other part of the transparency principle is fully informed participation. The wider the participation, the more robust will be the societal consensus on subsequent decisions.

3. Environmental Accounting for Sustainability

Although the input/output guides to sustainability (see below) are simple and straightforward, two tools are needed to implement them. First, in order to be able to maintain capital intact, as required for sustainability, we need to be able to detect depletion of natural resources. Depletion of natural resources in this context means any reduction in the services supplied by the environment to the human economic subsystem (Figure 1). Environmental source and sink services or functions must be maintained if sustainability is to be achieved. Depletion of environmental source functions include loss of topsoil, species extinctions, and overfishing. Depletion of environmental sink functions includes impairment of the environment's capacity to absorb wastes, damage to the ozone shield, over-accumulation of carbon dioxide pollution creating the greenhouse risks, and eutrophication. Only when environmental sources and sink functions are maintained intact can sustainability be achieved. Only then can harvest rates (source function), and effluent discharge rates (sink function) be kept within sustainable capacities. To detect and quantify the many use rates of these two classes of functions, we need environmental accounting (El Serafy 1989, 1991, 1992a, b; Ahmad et al. 1989).

Environmental accounting is essential to discern decapitalization, and to shift to using income rather than drawing down capital assets (Ahmad et al.1989, El Serafy 1989, 1991). Environmental accounting clarifies what is liquidation of natural capital from what is income. This is essential in the approach to sustainability because decapitalization is frequently confused as income.

The drawdown or conversion of some stock resources is a normal part of economic development: the conversion of iron ore into ploughs for example. Environmental accounting warns us when liquidation of potentially renewable resources exceeds their regeneration rates, such as many forests, fisheries and even clean air in places. It also indicates rules of quasi-sustainability in depleting non-renewable resources (ie: deplete at a rate equal to the rate of development of a renewable substitute per El Serafy's formula 1989, 1991).

countries tend to be poorer than is suggested by the accounts, and their growth may be quite different from conventionally calculated growth, or could even be negative where positive growth is shown.

3.1 Natural Resources as Capital

Natural resources represent capital that can and should be used -- or even used up -- to produce goods and services for the benefit of their owners. All natural resources need not be kept in their original state, either for our later use or for use by future generations. Like other forms of capital, however, natural resources need to be maintained in order that they can continue to help the productive process. Toward that end, if such resources are renewable, like forests or fisheries, annual or periodic exploitation should be kept within the natural rate of regeneration of the resource. If it exceeds that natural rate, and the capital stock is therefore diminished, the diminution should be estimated and imputed as disinvestment, and reflected in the measurement of national income. If exploitation falls below natural regeneration, then the owner would be adding to the final stock through a passive act of investment. Farmers call it fallow. Alfred Marshall called it the investment of waiting. Either way the change of stock should be assessed and reflected in the national accounts, though there is an established convention in accounting not to reflect any appreciation of stocks in current income, but wait until it is actually realized lest the capital base should get eroded by over-consumption. The usual way of effecting such an adjustment is to treat it as depreciation, deducting it from gross income or product, in order to arrive at an adjusted level of net income.

Valuation can be a formidable problem, but this problem is not totally insurmountable. Where the market indicates prices, the economist should base the adjustments on those. But often one has to resort to shortcuts and imputations, such as inferring the cost of soil erosion from the decline of crop yields. Full adjustment will, however, remain elusive, and all adjustments will inevitably be partial, and this has to be accepted.

Where resources cannot be regenerated and commercial exploitation leads inevitably to a diminished stock, such as in the case of non-renewables or mineral extraction, national account adjustment requires special treatment. Strictly speaking the income derivable from this stock, if it were to be liquidated in one go, is the annuity that can be earned from re-investing the proceeds. However, it may not be possible, or indeed prudent on account of market limitations, to liquidate resources so abruptly, but to continue to exploit them gradually over time, unearthing some, and leaving the bulk underground. The owner of the resource will decide the annual exploitation rate of the resource based on judgements of the resource market and future prices, the owner's current needs, technological constraints on exploitation, and the prevailing yield on alternative investments, etc. The rate of exploitation may or may not be judged optimal by the economist. But this is irrelevant. The accountant, however, has to estimate the owner's income (or profit or loss) during the year that is already past.

El Serafy's (1981) is the most effective method for estimating income from gradual exploitation, based on the proportion of the stock extracted in any one year and the rate of interest at which a certain portion of the receipts, identified as a "user cost," must be re-invested in financial or material assets in the natural resources being exploited have been depleted or when they approach extinction. Such is the importance of environmental accounting.

4. Environmental Assessment for Sustainability

The third essential to approach environmental sustainability is environmental assessment (EA). EA is the means by which environmental costs and benefits are estimated more reliably. Or, as Summers (1992) puts it, by "properly incorporating environmental costs into project appraisal".

Environmental assessment (EA) and sustainability are closely related in World Bank thinking. EA is the major operational tool to approach sustainability in projects so far available. Although sustainability is mandated by the World Bank, there are no clear guidelines available, as of yet, on how to approach it. This part summarizes the World Bank's new (October 1991) official policy on EA;[10] and then suggests ideas on how to use EA as a tool to approach sustainability.

The Purpose of EA: EA is part of the project selection process. Project-level EA is carried out during project preparation, and should be closely linked to the feasibility study of which it is an integral part. The World Bank's official policy is that purpose of EA is to ensure that the development options under consideration are environmentally sustainable. Any environmental consequences should be recognized early in the project cycle and taken into account in project selection, planning, siting, and design. EAs identify ways of improving projects environmentally, and preventing, minimizing, mitigating, or compensating for adverse impacts. Like economic, financial, institutional, and engineering analyses, EA is part of project preparation, and is therefore the proponent's responsibility.

By alerting project designers, implementing agencies, borrowers and finance agencies to issues early, EAs:

(a) enable them to address environmental issues early;
(b) reduce the need for project conditionality, because appropriate steps can be taken in advance or incorporated into project design, or alternatives to the proposed project can be considered;
(c) help avoid costs and delays in implementation due to unanticipated environmental problems;
(d) EAs also provide a formal mechanism for inter-agency coordination;
(e) EA is the main vehicle for addressing the concerns of affected groups and local nongovernmental organizations (NGOs);
(f) In addition, the EA process should play a major role in building environmental capability in the country.

[10] The text of the complete EA policy, technically known as "Operational Directive 4.01" (19 p.) of September 1991 is available from World Bank offices or Headquarters. This policy replaces, updates and strengthens the October 1989 version. The EA policy is amplified in the 1991 three-volume "Environmental Assessment Sourcebook" available from the Book Store, World Bank, Washington DC 20433, USA.

projects involving large scale resettlement, the proponent retains independent EA experts not affiliated with the project. Borrowers may request World Bank assistance for financing EAs through a Project Preparation Facility (PPF) advance, or from the Technical Assistance Grant Program for the Environment.

5. Guidelines for Environmental Sustainability

The following guidelines or 'rules of thumb' are prudent economics: presumably what Summers (1992) wants "honest" economists to use to improve their cost/benefit analysis, and to "incorporate environmental costs into the appraisal of projects". These guidelines seek to elaborate the principle of non-liquidation of natural capital, and to extend it to nonrenewable resources in so far as possible. It is a matter of judgement for CB analysts and EA teams to apply them in a reasonable way to diverse projects. Where the CB or EA finds wide divergence from sustainability, they should work with the project designers to narrow the gap as early in the project cycle as possible, preferably quite early during preparation.

The use of the terms "assimilative or regenerative capacity" should not be taken necessarily to imply that there is a continuous threshold of use intensity below which there is no effect on the ecosystem being used. Capacity can be thought of as a level of particular ecosystem use beyond which more intensive use would cause unacceptable (e.g., cumulative, irreversible, excessive) degradation of the ecosystem and reduction of its future services. Also capacity refers to the capacity of the relevant ecosystem, not to individual species in isolation.

There are many difficulties in defining sustainable yield and sustainable use, just as there are many analogous difficulties in defining income. But to answer Sir John Hick's unavoidable central question -- How much can we consume this year without reducing our capacity to produce next year? -- requires that we at least give a prudent rule of thumb. Also most of the complications of the simple sustainable yield model -- i.e., stochastic rather than deterministic, multi-species rather than single species equilibria -- simply result in reducing the sustainable annual offtake, and consequently reducing the amount that can be prudently consumed.

An organism, an economy, or a project all relate to their environment in basically the same way: they depend on the environment to supply useful inputs of raw materials and energy, and to absorb less useful outputs of waste material and heat. Either the environmental 'source' or the 'sink' capacity can be diminished through overuse. Each must be kept within the limit of sustainability. The basic operational principles of sustainability can thus be summarized in the form of an output rule and an input rule.

5.1 The Precautionary Principle

The final overall guideline to approach environmental sustainability is the precautionary principle. Ecologists and economists disagree on the imminence of global limits to throughput growth, on the rate of resource substitutions, and the rate of technological efficiency gains. The prudent view is that the costs of planning development with incorrect assumptions are much higher with overestimates of such rates than with underestimates. Exceeding carrying capacity reduces it for the future to below the level at which it was impaired. In many environmental capacities, the damage/response curve is not linear. Overshoot of a carrying capacity can exceed a threshold and lead to a sudden crash. This emphasizes the fundamental importance of the precautionary principle, a basic normative principle of international environmental law: "Rather than await certainty, regulators should act in anticipation of any potential environmental harm to prevent it" (Costanza and Cornwell 1992).

Application of the precautionary principle can be by a modified deposit-refund system which incorporates both risks and uncertain environmental costs [11] into the economic incentive system and promotes positive technological innovation. The "flexible environmental assurance bonding system" charges an economic agent directly for known environmental damage, and levies an assurance bond equal to the best current estimate of the largest potential future environmental damages. The bond is held in an interest-bearing escrow account for a predetermined time. Portions of the bond are returned, plus interest, if and when the agent demonstrates that the suspected worst-case damage had not occurred or would be less than originally assessed. Any damage that does occur is rehabilitated or compensated for from the bond account (Costanza & Cornwell 1992). Such a forced saving system shifts the costs of uncertainty and the burden of proof from the public onto the resource user. The resource user has strong incentive to reduce the uncertainty of the environmental impacts as soon as possible.

[11] Risk, or statistical uncertainty, is an event with known probability. Uncertainty, or indeterminacy, is an event with unknown probability. For example, car driving risks are so well known that they are used to set automobile insurance premia. Living near a toxic chemical dump imposes health uncertainties: no one knows the probability of health damage. Most environmental problems suffer from uncertainty, not merely risk (Costanza and Cornwell 1992).

6. Institution Strengthening for Environmental Sustainability

At the time of the 1972 UN Conference on Environment and Development in Stockholm, only about twelve nations possessed Ministries of Environment or equivalent agencies. Today there are nearly 200. In addition, many implementive ministries, such as that of energy or industry, have their own in-house environmental units. A potentially powerful more recent trend is for ministries of planning and finance and national development banks also to create their own environmental capabilities. Now all multilateral Development Banks have their own substantial environmental capability -- up from near zero in 1972. All leading multinational corporations and some commercial banks also have their own environmental capability. Many members of the UN system have or are creating their own environmental capabilities.

We believe institutional strengthening to be exceptionally important. Internalization of environmental externalities has required legally empowered institutions which are competent to set and enforce appropriate environmental regulations. Although we often assume they exist, that is seldom the case in developing countries. UNEP, created following the 1972 conference, needs to be reinforced, or other agencies assigned new responsibilities. One suggestion is to elevate care for global life support systems to the same status as the UN Security Council. The six most urgent needs for the near future are listed in Figure 8:

Figure 8: Institutional Priorities for Environmental Sustainability

1. **Monitor Standards:**
   Set and monitor environmental standards where none exist or where inadequate.

2. **Compliance:**
   Monitor international compliance with standards, treaties and agreements. The proposed UN Sustainable Development Commission looks highly promising.

3. **Enforcement:**
   Strengthen environmental enforcement capabilities (The UN's "Green Police" proposal).

4. **Coordination:**
   Coordinate UN's environmental work; dispute resolution mechanism needed between agencies.

5. **Mediation:**
   Mediate international environmental disputes, possibly the International Court of Justice, Hague.

6. **Institution Strengthening:**
   Foster the creation or strengthening of environmental capabilities in all relevant loci, wherever needed, such as in governments, industry, businesses, consulting firms, banks, religions, military, schools, academia.

This paper is restricted to the near term future. The Beijing Declaration (20 June 1991) suggests that nations which have incurred environmental debts from decades of unsustainable economic growth should also pay for them. The International Court of Justice should decide the extent to which historic use of commons and environmental sources and sinks should be subject to reparations. Clearly the globe will have to take account of ability to pay for the transition to global sustainability.

CONCLUSION

Sound economics, improved use of environmental assessment, environmental accounting, and direct guidelines are all needed in order to make the urgent transition to environmental sustainable development. Work is urgently needed on pragmatic means to get there (Annex 2). We conclude that improving microeconomic using environmental assessment, improving macroeconomics using environmental accounting, and adopting rules of thumb for sustainability are all needed if economic development is to become sustainable.

Let us not forget the core purpose of government: the safety of its citizens. Governments must protect individuals from the damaging actions of others. Governments must balance the legitimate profit motives of industry and its desire to spread costs widely by externalization. Less regulation, fewer environmental incentives, and more throughput growth that brought us to global limits is precisely the imprudent course.

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ANNEX I; DISAGREEMENTS OVER THE CONCEPT OF SUSTAINABILITY

There divergence in the literature on sustainability. This is ominous because approaching environmental sustainability is arguably the most important goal facing humanity today. The lack of convergence is illustrated by the following:

> " Sustainability has come to be used in recent years in connection with projects. This is more of a buzzword -- probably derived from the environmental lobby -- than a genuine concept. It has no merit. Whether a project is sustainable (forever? -- or just for a long time?) has nothing to whether it is desirable. If unsustainability were really regarded as a reason for rejecting a project, there would be no mining and no industry". (Little and Mirrlees 1990). They footnote this extraordinary putdown of sustainability with the sentence "Sustainability is also described as a 'central notion' in the extraordinarily vapid document, Principles for Project Analysis, DAC, OECD Paris (1984)." [12]

The World Bank's Chief Economist writes that the idea of sustainability has drawn attention to environmental problems that were ignored for too long, but that sustainability does not need to invoke special criteria. "Chanting the mantra of sustainability is not enough". But then he goes on to admit that projects evaluated by standard criteria have caused environmental damage.... because environmental costs

[12] When subsequently challenged on this point, Little admitted that he accepted the concept of Hicksian income, which is the fundamental underpinning of sustainability, and that he approved of investments in asset maintenance.

ANNEX 3:
EXAMPLES OF SUSTAINABILITY INDICATORS CALCULATED AT THE NATIONAL LEVEL[16]

1. **Greenhouse Gases.** Global sink capacity may be derived in a crude fashion by simply examining annual global emissions for a gas versus the annual increase in ambient air concentrations of this gas. Using this method, the atmospheric sink in 1989 for CO^2 was 14,795,349,000 metric tons while that for CH^4 was 235,055,000 metric tons. There was no sink for CFCs. Emission levels which exceed these sink capacities will lead to increasing air concentrations. The sink is apportioned out to countries based on an average of their relative (to the world) land mass and 1989 population. Using this method, the United States, for example, exceeds its CO^2 quota by 3,976,911 metric tons, its CH4 quota by 22,837 metric tons and its CFC quota by 130 metric tons. Mali on the other hand has under-emitted with 80,671.8 metric tons and 978.4 metric tons of unutilized CO^2 and CH^4 sink respectively to spare.

2. **Soil Degradation.** One way of examining the degradation of soil is to look at the ratio of crop production to fertilizer use per hectare. While this ratio is confounded by many other factors (particularly rainfall and the use of other inputs) it should reveal basic trends. When this ratio is examined one finds, for example, that Kenya's ratio decreased by 57.41% between 1980 and 1990 or that this figure for Mexico decreased by 28.7% during these same years. Sweden on the other hand was able to increase this ratio by 69.4%. All of these countries saw very little change in irrigated land as a percentage of cropland during this time (limiting the potential for this to be a confounding factor). It is notable however that Kenya and Mexico were increasing their use of commercial fertilizers during this time while Sweden was decreasing its use of these substances.

3. **Energy Intensity.** The commercial energy intensity of aggregate output (megajoules/1987 $US of GNP) is a good measure of efficiency for industrialized countries but a poor one for developing countries where traditional fuels (whose consumption is not captured in this measure) may account for a large percentage of energy use. Japan for example has consistently increased efficiency from 12.42 megajoules/GNP in 1970 to 5 in 1989. The U.S. has also increased efficiency, going from 24.07 megajoules/GNP in 1970 to 15 in 1989, but at absolute levels yet to approach those of the Japanese.

4. **Renewable Energy Proportion of Total Electricity Production.** Countries vary widely in their use of renewable energy resources. In general, smaller economies, with lower energy demands, have an easier time decreasing their reliance on electricity produced from nonrenewable sources. When one considers hydro, geothermal, wind and solar generated electricity, one finds that Nepal, for example, has increased its renewably generated power from 92.03% in 1985 to 95.59% in 1988 or that Kenya has increased from 80.9% to 93.04% during these same years. Japan, by contrast, has slightly decreased its renewables percentage from 13.31% in 1985 to 12.9% in 1988.

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16 Examples taken from Moseley (1992).

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