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# OFFICE MEMORANDUM

DATE November 23, 1983

TO Ms. Nancy Birdsall, CPDRM

FROM James A. Lee, EPDES

EXTENSION 75366

SUBJECT World Development Report VII Background Paper on Carrying Capacity -  
Environment Linkages

*file: James Lee  
1-6-139  
cc: CT (Also put  
into background  
paper box)*

1. In accordance with the arrangements made last September, the Office of Environmental and Scientific Affairs (OESA) is pleased to provide a background paper on the environmental implications of carrying capacity and population growth. The paper was prepared by George Ledec and Robert Goodland of OESA, along with consultants James Kirchner, Janet Drake, Vaclav Smil, and Herman Daly. It has also been reviewed by other OESA staff. Questions concerning particular points in the paper should be addressed to Mr. Ledec at Extension 75339.

2. If you consider it appropriate, OESA would be pleased to present a seminar on this paper, as other WDR background paper authors have done. Messrs. Ledec and Kirchner have indicated their willingness to give such a presentation.

3. We are grateful for the opportunity to contribute our views to the WDR on this vital topic.

Attachment

cc: Ms. G. Swamy, EPDGL  
Ms. S. Cochrane, PHNPR  
Mr. J. Kirchner, CPD  
OESA staff

GLedec:OMc

CARRYING CAPACITY, POPULATION GROWTH, AND  
SUSTAINABLE DEVELOPMENT

World Development Report VII Background Paper

Office of Environmental and Scientific Affairs

Contributors:

J.W. Kirchner  
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V. Smil  
H.E. Daly

November, 1983

### The Concept of Carrying Capacity:

The carrying capacity of a particular region is the maximum population of a given species that can be supported indefinitely, allowing for seasonal and random changes, without any degradation of the natural resource base that would diminish this maximum population in the future. The concept of carrying capacity is familiar to biologists and wildlife managers, who devised it to express the capacity of natural areas (ecosystems) to support animal life. With modifications, it is also an important measure of the ability of regions to support human populations. Carrying capacity is, therefore, an important concept for the work of development economists, planners, and political decision makers.

In the study of natural ecosystems, application of the carrying capacity concept is relatively straightforward. For example, the number of deer that can survive in a temperate forest may be determined by the availability of winter browse. In such a case, if too many deer are born in any given year and the surplus is not removed by predation, disease, or other means, winter starvation will reduce the population to the forest's carrying capacity. In other words, the deer population is constrained by the availability of food in the winter.

In ecosystems managed by humans, defining and measuring carrying capacity is essential for sustainable natural resource use. On managed rangeland, for example, humans have controlled the predators that would have limited the population of grazing animals on natural rangeland. Consequently, ranchers must assess the carrying capacity of the range and control the grazing herds accordingly. If the herd size exceeds the long-term carrying capacity of the range, immediate starvation (as in the case of the forest

deer) is unlikely. Instead, the animal production of the range probably will increase for a brief period. Over the short term, more grass will be converted to meat. Over the long term, however, overgrazing will interfere with the reproduction and growth of the range grass, ultimately causing irreversible damage to soil productivity, thereby reducing the number of animals that the range can feed. Overgrazing boosts animal production briefly, but does so at the expense of permanently eroding the carrying capacity of the rangeland resource base.

As this example illustrates, it is usually possible to exceed the carrying capacity of a region temporarily. A natural resource base cannot sustain a population beyond its carrying capacity indefinitely, however, and will suffer a reduction of its inherent productivity as a result of being overexploited. Managing such resources is difficult because the decline of the carrying capacity is usually evident only some time after the damage has been done, and because over the short term the production of the resource has actually increased.

A useful analogy is an interest-bearing bank account. The "carrying capacity" of the bank account is the interest. It is possible to siphon off the interest without impairing the account's ability to produce more interest. However, if money is withdrawn from the account faster than it is being generated (thereby temporarily increasing the "yield" from the account) the process is unsustainable, as the future "carrying capacity" of the account is reduced. Similarly, the carrying capacities of some ecosystems can be exceeded for a while, but they cannot be exceeded sustainably.

Thus far, this discussion of carrying capacity has considered only one kind of resource, food. Food availability readily comes to mind in discussions of carrying capacities of developing regions, since it can be a constraint to population growth. However, in highly concentrated urban

centers (if food is readily available through trade with outlying areas), the carrying capacity is often determined by other factors, such as the availability of living space or the ability of natural or human-designed systems to dispose of wastes and pollutants. In other areas of the world, future population growth may be constrained, not by the supply of food itself, but instead by the availability of fuelwood to cook it. A region's carrying capacity is ultimately determined by its scarcest vital resource.

A region's carrying capacity exists for humans, as it does for every other form of life. To date, little effort has been spent on defining and measuring the human carrying capacity of natural systems. Applying the carrying capacity concept to humans is also complicated by several factors. One such factor is that per capita natural resource consumption by humans is often extremely variable whether within the same society or among different societies competing for the same natural resources. Another complicating factor is people's ability to control, to some extent, the natural resources upon which they depend. Unlike other species, human beings can expand the carrying capacity of their environment by using technological innovation and trade. However, humans can also diminish the carrying capacity of a region through various forms of environmental mismanagement leading to long-term natural resource degradation. Such human-induced degradation often results from various short-term human pressures, which occur largely in response to rapid population growth. These points are elaborated in the following three sections.

#### The Role of Technology:

Through technological change, humans can increase the productivity of natural resources, thereby expanding the carrying capacity of a region. Technology can increase the carrying capacity of a given region in two ways. First, it can allow people to substitute, to some limited extent, a natural

resource that is not scarce for one that is. Fertilizers, for example, allow farmers to compensate for a shortage of arable land by applying chemicals that are not in short supply--at least until the petrochemical or coal feedstocks used to synthesize many of them become too expensive. Second, technology can increase the efficiency of conversion of natural resources into economic goods, thereby allowing people to "squeeze" more economic value from a given natural resource base.

While technological advances can expand the carrying capacity of a region to a considerable extent, they ultimately reach diminishing returns and do not make unlimited population growth possible. For example, at high application levels, fertilizers exhibit sharply declining marginal returns and cause serious environmental complications (such as eutrophication of lakes and health-endangering nitrate levels in drinking water). At some point, increased fertilizer use will result in nutrient "poisoning" of crops and an actual drop in yields. By contrast, some production functions used in economic analysis (such as the Cobb-Douglas function) assume that factors of production are infinitely substitutable for one another, and that using any resource more intensively guarantees an increase in output.

Moreover, technology cannot increase the total quantity of natural resources ultimately available on this planet. It cannot create more raw materials out of nothing--nor can it increase the efficiency of conversion of these materials into economic goods beyond the constraints imposed by the physical laws of thermodynamics. For example, intercropping or rotation cropping of compatible species can result in greater food "outputs" from the same farm "inputs", but no conceivable combination of technologies could produce more food energy "output" than was available as (solar and other) energy "input" to the farm. Therefore, no technological advance can eliminate natural resource constraints entirely. Furthermore, technology cannot



increase the Earth's natural waste assimilation capacity, although it can be used to reduce the volume of pollutants or other wastes that are generated. Thus, while technological advances can expand a region's carrying capacity to some extent, they cannot replace the need for eventual population stabilization. In the shorter term, the rate of population growth cannot exceed the rate at which technological advances increase carrying capacity without reducing people's standard of living and risking an overshoot of the carrying capacity.

China provides an example of both the potential and the limitations of improved technology for expanding carrying capacity in terms of food production. In China, the carrying capacity has increased substantially as the intensity of food production has risen and new management practices and technologies have defined more productive agro-ecosystems. For example, in a pastoralist China, one hectare of grazing land could support only 1-2 persons. Traditional farming with careful recycling of organic fertilizers raised the carrying capacity to 5-6 people per hectare. Today's cultivation, relying increasingly on large inputs of nitrogenous fertilizers, can sustain 10 people per hectare as the national average; in Sichuan, China's most populous province, 17 people are fed from each hectare.

Carrying capacity has thus been raised impressively over the past several thousand years in China. However, as some constraints to food production were removed (e.g., dieback of herds during cold winters or crippling pest damage to crops), new ones have emerged in their place. Today, China's carrying capacity rests critically on the availability of fossil fuels and electricity to provide synthetic fertilizers and to pump the water needed for new, high-yielding crop varieties.

Carrying capacity is thus not an immutably fixed number. Proper management of areas endowed with suitable soils, moisture, and growing season can raise carrying capacity by minimizing or even removing old constraints. But new constraints always emerge, and even in the best croplands there is a limit to continuous, steady improvements. Moreover, areas of marginal or poor cropland are suffering from severe soil erosion and degradation, deforestation and a resultant increase in flooding, desertification, and toxification. Such environmental stresses suggest that the carrying capacity of these regions has often been reached; even the best available practices may not be able to accomodate all of the people living in such stressed regions.

The Role of Trade:

Another means of pushing back natural resource constraints is trade. Trade can expand local carrying capacity by exchanging resources that are locally plentiful for those that are locally scarce. For example, countries in the Persian Gulf can support populations far in excess of their local agricultural carrying capacities by trading oil for food. Similarly, city-states such as Singapore and Hong Kong support population densities roughly 100 times higher than the local carrying capacity by paying for food with the value added to labor-intensive goods. In other words, trade allows one region to make use of the excess carrying capacity of another.

Trade can expand local carrying capacities only in certain circumstances, however. The resource that is scarce in one region (e.g., food) must be available in surplus elsewhere, and the region's plentiful resource (e.g., oil, phosphate rock, or cheap labor) must be scarce elsewhere. Trade cannot alleviate global scarcity, as there is no other "globe" nearby with which to trade! The difference in value between the exported and imported goods must be enough to pay the costs of transportation

both ways, which for small, remote, or landlocked countries (or those lacking good internal transportation) can be enormous. Transportation costs are a particularly great obstacle to commerce in high-bulk, low-value commodities such as food staples, or many raw materials. As fossil fuels become more scarce and their cost rises, many opportunities for trade are likely to become uneconomical because of higher transportation costs.

Finally, there is a distributional issue that is easily overlooked if the country is treated as the basic unit of analysis. The foreign exchange earned by the exports must somehow find its way into the sectors of the economy that need the imports in question. For example, if rural people export cash crops rather than growing their own food, distribution mechanisms are needed to ensure that these people will be able to buy enough food to meet at least their basic needs.

The examples of Singapore and Hong Kong, which survive by marketing the value added to goods by human labor, deserve special attention. Many nations would like to emulate their relative affluence, despite their high population densities and lack of exploitable natural resources. Of the many countries that would like to be the next Hong Kong, any one could conceivably succeed. But they probably cannot all succeed in doing so, because there does not seem to be a sufficiently large, unmet global demand for human labor to add value to goods. With unemployment at relatively high levels in even the world's most affluent countries, and with population growth swelling the world's labor force every day, it seems unrealistic to expect that most of the Third World will be able to solve its carrying capacity problems by marketing its surplus labor through international trade.

Human-induced Reduction of Carrying Capacity:

Societies display two very different patterns of adaptive response to carrying capacity constraints. The first is to bring the population and the carrying capacity into balance by limiting the former, or, more commonly, expanding the latter. The second pattern of adaptive response is to exploit the resource base beyond its carrying capacity (akin to "deficit spending" in the bank account analogy), thereby liquidating natural capital for one-time use.

It is difficult at first to distinguish these two patterns of adaptation, because their short-run effects are superficially similar. In both cases, the supply of goods per capita increases in the short run. But the difference between the two approaches is crucial. The first is sustainable, while the second damages the long-term carrying capacity. Recognizing this difference is both difficult and vital, because any damage is likely to be apparent only after a substantial time lag and after it has become largely irreversible.

When populations press against or exceed the limits of their natural resource base, they are driven by their circumstances to patterns of adaptive response that are not sustainable. It is cheaper, in the short run, to exploit a resource base beyond its carrying capacity than it is to expand the carrying capacity or to limit population growth. Populations that have reached their upper limits, and whose surplus resources are in critically short supply, will adapt to their circumstances in the cheapest possible way (particularly if the competitive market is the only mechanism of adaptation). In so doing, they will ultimately decrease the productivity of their natural resources, and thus generate even stronger pressures for the same counterproductive patterns or adaptation. The result is a downward spiral of resource productivity and living standards.

It appears from historical records that some of the world's most advanced societies have been destroyed by following the second path of adaptive response. A growing number of scholars believe that the Mayan civilization vanished when population pressures caused deforestation and soil erosion, resulting in the collapse of its agricultural system (Deevey, et al., 1979). Valleys in Greece that once were the site of some of the most intensive irrigated agriculture in the western world will now support only scrub growth and grazing animals. During the days of Caesar, northern Africa was the granary of the Roman Empire; it has long since been unable even to feed itself.

Fortunately, science has provided the means for averting similar disasters. We can detect natural resource degradation in time. What is needed is the political wisdom to act on the signs that indicate that a particular pattern of development is not sustainable. Later in this paper, we detail some illustrative scenarios of local populations and carrying capacities that are, or soon may be, out of balance.

#### The Global Carrying Capacity Debate:

Ever since the days of the British economist Thomas Malthus, the question of global carrying capacity has been a subject for lively discussion. Despite this discussion, which has greatly intensified during the last decade, no consensus has emerged on this issue.

Some scientists, such as Westing (1981) and Mann (1981) argue that the world cannot sustainably support a human population of more than about 2 billion. Westing (1981) bases his calculation on such assumptions as:

- (1) A global level of per capita consumption that is "affluent", i.e., the average of those of the world's 27 richest nations.

- (2) Existing levels of technology.
- (3) Existing policies and practices of natural resource utilization, i.e., no major changes in market or non-market mechanisms to encourage increased efficiency in natural resource use.

Based on this analysis, there are several reasons why the world is presently supporting a population that is substantially in excess of its carrying capacity. One is that a sizable proportion of the population does not have an "affluent" level of per capita natural resource consumption. Another is that nonrenewable natural resources, 1/ particularly fossil fuels, are being exhausted, thus enabling humanity to live "on borrowed time" in excess of its carrying capacity. A third reason is that renewable natural resources (such as soils, grazing lands, forests, and fisheries) are being overexploited at unsustainable rates, thereby temporarily increasing present production at the expense of future production. The logical conclusion from this analysis is that the human population should be stabilized and subsequently reduced by all humane means possible, in order to bring it into balance with its carrying capacity.

At the opposite extreme are persons such as Simon (1981)) and Kahn (1982), who insist that the world's natural resources are not meaningfully finite, or at least are sufficient to support unrestrained population growth for centuries to come. To support these views, Simon and Kahn cite what they believe to be the huge size of the Earth's remaining natural resource base,

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1/ Renewable natural resources include living resources (plants and animals) and other natural resources (particularly soil and water) that create or sustain life and that are self-renewing if not overexploited or otherwise mismanaged. Nonrenewable natural resources are not self-renewing. They include minerals (which can often be profitably recycled) and fossil fuels (which cannot). Care is also required in the extraction and processing of nonrenewable resources to prevent unnecessary environmental damage.

the ability of technological progress to advance more rapidly than population growth, and the ability of market forces will automatically keep natural resources and the demand for them in balance. In this view, there is no need for efforts to stabilize population size.

In between these extremes are a variety of estimates of global carrying capacity. Some of these estimates are in excess of the most recent United Nations projections of future stationary population size. For example, Kovda (1980) has stated that in the view of some Soviet scientists, the world can support a population of 14 billion. On the other hand, other estimates are lower than projected future population size. Gilland (1982) suggests a global carrying capacity of 7 billion.

Aside from the poor quality of much of the available natural resource data, the principal reason for such huge discrepancies in global carrying capacity estimates (ranging from 2 billion to no limits) is the very different assumptions that are used. Among the most pivotal assumptions which influence global carrying capacity estimates are the following:

- (1) The rate at which advances in technology can sustainably expand carrying capacity. In this regard, a critical question is the rate of such technological progress versus the exponential growth rate of population.
- (2) The size of the essential natural resource base.
- (3) The extent to which market or non-market (political or social) mechanisms will ensure the efficient use of scarce natural resources.
- (4) Levels of per capita consumption of natural resources.

As this controversy shows, the actual carrying capacity of the planet is unknown and perhaps unknowable. In the face of such uncertainty, it is most prudent to proceed cautiously. It would be inadvisable to rush headlong

into a possible confrontation with our limits to growth, foreclosing options for the future along the way. Even if incontrovertible evidence existed that technological progress can continue to expand global carrying capacity indefinitely, there is still the crucial issue of timing--over time, the rate of population growth must be no more than the rate of carrying capacity growth, if carrying capacity is not to be exceeded.

Carrying Capacity and Optimal Population Size:

The global carrying capacity debate is one of how large the earth's population could become, not how large it should become. The optimal population size is not necessarily the same as the carrying capacity. Human populations can be sustained at any level up to the carrying capacity of the natural resources that support them. A common assumption is that the population should be encouraged--or at least allowed--to grow just to the carrying capacity, and stabilize there. Implicitly, then, many people believe the largest possible population size to be also the optimal population size.

There is no a priori reason why this should be the case. Populations pressing against their carrying capacities are likely to have low standards of living and slim prospects for substantial socioeconomic improvement. The definition of what population size is "best" is inherently a matter of value choice rather than scientific fact. Many human values are, arguably, better served by a stable population size substantially below the carrying capacity.

For populations just at the limit of the carrying capacity, vital resources are in critically short supply. There is no surplus. Because resources are being spread among as many people as possible, per capita consumption of goods is at the lowest possible level. This realization demonstrates the fallacy of Bentham's credo, "the greatest good for the



greatest number" (aside from the logical impossibility of double maximization). Moreover, it shows that the concept of carrying capacity embodies critical social choices.

Some people maintain that human welfare is essentially independent of population size. In this view, the productivity of each worker is a constant, so each doubling of the population will--by definition--double the productivity of the economy as well. This argument overlooks the fact that as the population grows, the raw materials available from a constant resource base will provide fewer inputs per worker. Therefore, all else being equal, the productivity of the economy per worker, and thus the level of goods available per capita, must decline as a growing population approaches the carrying capacity.

The main implication of this analysis is that, beyond a certain population density, a fundamental tradeoff always exists between further increases in population size versus per capita consumption. To illustrate this point, Thomas Malthus stated that there should never be more people than can enjoy a piece of meat and a glass of wine with each dinner. This statement implies, of course, that population density should be sufficiently low to enable enough land to be used to produce such "luxury" products as meat and wine for everyone. While not all cultures place a high value on meat or wine consumption, the desire to consume at a level in excess of bare survival needs is almost universal. People will disagree on the ideal choice between more people versus a higher standard of living per person. However, if societies do not make such choices through population policy decisions, their population growth may proceed to a point where a large population with low per capita consumption is unavoidable.

Not only conventional economic goods be shared by more people as the population grows, but noneconomic and "amenity" goods become scarcer as well. For example, open space, natural recreation areas, and wildlife become scarcer as more land is allocated to meeting the food, housing, and other needs of a growing population. Leisure time becomes more dear as more time is required for providing for basic needs (because, as noted above, the labor efficiency of the economic process decreases as natural resources become scarce). In the Gambia and central Tanzania, for example, population growth has made firewood so scarce that each household requires 250-300 worker-days to meet its annual fuelwood needs (FAO, 1978; Moris and Openshaw, 1979).

Moreover, as natural resources become more scarce, the administrative structure and coercion required to enforce efficient resource allocation increases. For example, allocation of irrigation water where it is scarce has long been a source of friction between nations and among factions within individual countries. Even when farmers have decided on a formula for dividing the water supply, they must also agree to coordinate all of their cropping activities. Greene, 1966 notes:

"Failure to observe these practices injures not only the individual farmer but his neighbours also; irrigation implies a uniformly high standard of farming; losses are severe if this is not kept up."

When populations press relentlessly against (or temporarily exceed) the limits of their local or national carrying capacity (no matter how much it is augmented by trade or technology), the development process can be crippled. Economic development depends upon the successful reinvestment of surplus resources. When a population reaches the carrying capacity of a region, such that all the region's available resources are supporting the largest possible number of people, all production is devoted to immediate consumption needs. There is no surplus to invest for the future.

There are profound value judgments implicit in declaring any one population size as "optimal" for a given country or region. The only imperative is that no population can be supported sustainably above the carrying capacity provided by the available natural resources. Because population size and per capita consumption are ultimately constrained (at some uncertain limit) by natural resource availability, and because (in modern times) it is much easier to allow a population to grow than to force it to contract, the path of caution is to seek as little population growth now as possible. In so doing, we would foreclose the fewest lifestyle and resource use options, and preserve the widest range of choices for future generations.

The Role of Population Growth in Environmental Degradation and Natural Resource Scarcity:

When international development specialists discuss "the population problem," they are actually confronting two distinct, though obviously related, classes of issues. The absolute population size of some countries, or regions within countries, threatens their standard of living and the viability of their natural resource base. The rate of population growth of other countries and regions, even those with relatively low population densities, is sufficient to cause severe economic, social, and environmental dislocations, while foreclosing a range of options for the future. Even if a country's population size is well below its optimum level (however "optimum" might be defined), its rate of population growth may be well above the optimum.

It should be evident from the preceding discussion that the population size and population density of countries are not per se the causes of problems such as natural resource degradation or hunger. Rather, these problems arise when the population becomes too large in relation to the productivity of the resource base upon which it survives. Low population densities do not necessarily mean that carrying capacity constraints pose no

problems. Most of the "empty quarters" of the world are empty for a very good reason: their resources cannot support many people. Africa provides perhaps the clearest example of how much of a seemingly "underpopulated" continent may, in fact, be too crowded.

SUGGESTED BOX: AFRICA: THE CROWDED CONTINENT

Africa seems, at first glance, a vast and empty continent. But on closer inspection, it appears that many countries in Africa are becoming very crowded indeed. Africa has been described as "underpopulated" because its population density is relatively low. Compared with most of Asia or even Central America, Africa seems uncrowded. Population density, however, is just one side of the population-natural resources balance; land productivity is the other. About 50 percent of the continent cannot be considered cultivable. Half the potentially arable soils are lateritic, and thus largely unsuited for permanent field crop agriculture. Of the land that is arable, only 7 percent has naturally rich alluvial soils (Revelle, 1976). Much of Africa's drier land can support only economically marginal, land-extensive uses, such as nomadic pastoralism, or, at best, only one meager grain crop per year. There are frequently good reasons why vast, unsettled areas have remained so. It was not by chance that they were left until last. Many regions that are unsettled today are empty precisely because they cannot support sustained settlement.

There is evidence that Africa's population is even now straining the continent's renewable natural resource base. According to a recent FAO study (Harrison, 1983), almost half of Africa's land area is unable to support its current population, using current technology. By the year 2000, the study concludes, 30 countries out of 51 in the region will be unable to feed their populations with current levels of inputs. Increased technological inputs,

such as irrigation, can improve yields, but at great financial expense, and with high environmental costs and public health risks (Tillman, 1981). As real energy costs rise, so do the costs of irrigated agriculture, which depends on electricity or liquid fuel for pumping, and often also upon such energy-intensive inputs as fertilizers and biocides. 2/ Excessive irrigation in dry climates often leads to salinization or alkalinization of crop land, such that much of the available water must eventually be used to flush away salts, rather than to irrigate crops.

Population growth rates in Africa are among the highest in the world. At current growth rates, Africa's current population of nearly 500 million will double in less than 30 years. Where high-potential lands already are crowded, the population spills over onto marginal lands, which produce low yields and are often susceptible to rapid degradation in the absence of proper management. These marginal lands are farmed ever more intensively as human numbers grow.

Yield figures suggest the stress on Africa's natural resources. Between 1969-71 and 1977-79, average annual yields of maize, millet, wheat, and cotton declined for the continent as a whole. Yields of sorghum, groundnuts, and pulses were lower in 1977-79 than in 1961-63 (World Bank, 1981). Declining yields per hectare often indicate either that more marginal land is coming into production, or that the fertility of the land is declining through overuse. Such land degradation severely reduces future carrying capacity.

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2/ Biocides, literally chemical "killers of life", is the generic category which includes herbicides, insecticides, fungicides, molluscicides, rodenticides, etc.

Declining food production per capita is another indication that population growth is outrunning the land's resources. For the continent as a whole, food production per capita declined 9 percent between 1969-71 and 1977-79. In 1980, 26 nations in sub-Saharan Africa relied on food imports for meeting the basic needs of their populations. Food imports per capita rose 15 percent in the region between 1974 and 1979 (World Bank, 1981) (END BOX).

Food Supply:

Chronic hunger and starvation do not arise purely by chance. They are caused by population growth outstripping agricultural production, by severe poverty, and by economic and environmental mismanagement.

Nearly sixty percent of the people of the developing world live in regions that have insufficient agricultural resources to support their current population densities, even if all their cultivable lands were put into production, using current technologies. That surprising statistic is the result of the most complete study of population and carrying capacity to date, to be released soon by the United Nations Food and Agriculture Organization (FAO). According to a preliminary report on this study, the developing world as a whole has the potential to support nearly twice its existing population, even with the relatively inefficient agricultural techniques currently in use (Harrison, 1983). However, both agricultural resources and human populations are distributed very unevenly among countries and regions, leaving many countries' food security in a precarious position.

The ratio of population to food production has become increasingly less favorable in recent years. FAO's World Food Surveys indicate that in many regions, population growth has slowed, but the growth in food production has slowed still further. Global per capita food production once was growing, but is now declining (FAO, 1977a).

Egypt is a telltale example of the growing imbalance between growth in population and food production. For example, while Egypt's population growth rate between 1960 and 1976 dropped from 2.5 to 2.4 percent per year, its agricultural production growth rate fell from 3.3 to 1.4 percent per year. Despite the Aswan High Dam, the total area of irrigated farmland in Egypt has remained largely unchanged through the last two decades. While additional areas are being brought under irrigation, existing arable lands are being lost to urbanization. Moreover, salinization, alkalinization, and waterlogging are impairing agricultural productivity on much of the existing irrigated cropland.

Kenya's experience illustrates how one country's food security prospects can rapidly shift from optimistic to grim. Kenya's population growth rate remained roughly constant, at 3.3 percent per year, over the period 1960-1976. During the 1960's, cereal grain production grew even faster, at 5.5 percent per year. But between 1970 and 1976, growth in agricultural production stopped (FAO, 1977a). Cereal production per capita, once growing at 2.1 percent per year, was shrinking at 4 percent per year by the end of the period. Under exponential population growth, with short doubling times, change comes quickly indeed.

The distribution of income and nutrition can reveal hunger that is hidden in statistics describing average living standards. Ghana, according to the 1977 FAO World Food Survey, grew enough food in 1972-1974 to meet its people's food energy requirements of 2300 kcal/person/day. During the same period, however, one out of every five Ghanaians was undernourished, with a calorie intake of less than 1500 kcal/person/day (FAO, 1977b). High population growth rates tend to widen income disparities and reduce the living standards of the "poorest of the poor" further still.

Some regions have sufficient natural resource endowments to support significantly larger populations in the future. However, in many cases it may be impossible to develop these resources quickly enough to support high rates of population growth. When populations grow rapidly, resources must be diverted from development to basic sustenance. The acceleration of the Mahaweli Ganga regional development program in Sri Lanka illustrates how this problem arises.

SUGGESTED BOX: THE ACCELERATED MAHAWELI REGIONAL DEVELOPMENT PROGRAM

The Mahaweli program was originally conceived as an ambitious plan to relocate one out of ten of Sri Lanka's people in previously undeveloped lands, triple electrical generating capacity, cut unemployment, and guarantee food self-sufficiency. Begun in the 1970's as a 30-year program, the Mahaweli scheme became more ambitious still when it was "accelerated" to a six-year plan in 1977. Like any large project, the Mahaweli program has had its problems. Some of these problems, however, have arisen entirely from accelerating the program, in response to the social, economic, and political pressures resulting from rapid population growth.

The frantic pace of the accelerated development scheme made successful planning very difficult. In the rush to begin the program, for example, too little thought was devoted to planning a road network. Had the development plan been pursued more slowly, there would have been time to correct the problem when it became obvious. The short timetable of the Mahaweli plan also made it difficult to arrange financial assistance quickly enough.

Perhaps the most ominous consequence of the speeding up of the timetable, however, has been the resulting emphasis on activities that generate output in the short term rather than on those that protect important



natural resources for the long term. For example, the hillsides above the Mahaweli River are severely deforested. Replanting efforts have been too little, too late, because most of the program's resources have been devoted to making the dams and the croplands productive as soon as possible. Ironically, the productivity of the very dams and croplands is now threatened by sedimentation, as the denuded hillsides are eroded by rains.

Similarly, the trees that will be needed near the settlements to provide fuelwood have not yet been planted. For the moment, fuelwood is plentiful because the forest is being cleared for cropland. But when land clearing stops, the immediate supply of fuel will stop as well. Without woodlots, either severe fuel shortages or deforestation and watershed damage will result.

The final irony of the accelerated Mahaweli program is that even this crash program is not enough. Even if the full program were completed in the intended six years, it would not keep pace with Sri Lanka's population growth during this time. (END BOX).

Of course, population growth is not the only cause of hunger in the Third World. In some countries, it is not even the primary factor. Economic mismanagement, such as pricing policies that provide inadequate producer incentives, can stifle agricultural productivity in countries well endowed with natural resources. Environmental mismanagement, such as land use and land tenure policies that encourage the farming of marginal lands, can cause permanent damage to the agricultural potential of a region.

Deforestation:

Population pressures in much of the Third World are leading to deforestation on a massive scale. Deforestation, in turn, is causing acute human suffering, reduction in carrying capacities, and long-term damage to the prospects for sustainable development in many areas.

Demand for firewood is a leading cause of deforestation, particularly in the more arid and high altitude regions where wood grows relatively slowly. In many areas, the population has grown beyond the carrying capacity of the local wood supply. In order to meet their daily energy needs, 1.3 billion people must cut firewood faster than it can be replaced by natural regrowth (Poore, 1983). As the forest are depleted by overcutting, the carrying capacity falls still further. As sustainable production falls, the tree stock is depleted still further. If uncorrected through some type of intervention, this process continues until no economically accessible tree stock remains.

Unfortunately, it is often difficult for those who are depleting the "natural capital" of the forest to recognize that they are doing so (or to have the means available to control it). Obtaining adequate wood supplies is typically seen simply as a problem of cutting enough wood, not as one of protecting the resource base that supplies wood. Usually the depletion of the tree stock is apparent only because obtaining adequate supplies has become difficult.

Managed village woodlots or more efficient wood stoves could greatly expand the energy component of the carrying capacity of these regions. However, successful introduction of fuelwood plantations, energy-efficient stoves, and other forest-conserving measures is often not easy. Such measures require local testing and adaptation, large numbers of trained personnel, and adequate economic and institutional incentives to succeed. For example, people will not plant trees on public lands if they fear that other persons will cut them down. Even in areas of low population density (e.g., much of sub-Saharan Africa), rapid population growth impedes forest conservation efforts. The large outlays of private and public capital needed for

successful reforestation are diverted instead into supporting the rapidly growing population. Skilled administrative talent, one of the scarcest resources in most developing countries, is used for managing societal adjustments to high population growth, rather than for preserving economic and social sustainability through reforestation or the other activities needed to keep the natural carrying capacity from declining.

What does firewood scarcity imply for the quality of life of Third World families? In China, more than 70 million (out of 170 million) rural households--about 350 million people--suffer serious fuel shortages for up to six months each year when crop residues are exhausted and wood is unavailable in deforested areas (Smil, 1983). In much of West Africa, two meals were traditionally cooked each day. Now many families can only eat cooked meals once each day or once every other day, because wood is so scarce (FAO, 1978; Hoskins, 1979). In Senegal, according to one peasant, "one can starve with a full granary if one has no fuel with which to cook the meal" (Hoskins, 1979). Soybeans have been introduced in Upper Volta. They are exceptionally nutritious and have grown well, but they have not been used widely because they require long cooking times (Hoskins, 1979). Similar experiences have been reported in Haiti (FAO, 1979). To the extent that there is insufficient fuel to heat foods and boil water, diseases spread more rapidly. As the forest perimeter is cut back, families unable to afford kerosene must devote increasing amounts of labor or income to obtaining firewood. These resources are necessarily diverted from improving the household's living standards.

Another major cause of deforestation is the expansion of agriculture. According to FAO, over 11 million hectares of forest are being cleared annually by the extension of agriculture onto marginal lands (Poore, 1983), primarily in response to population pressures. These marginal lands

are usually unable to support permanent agriculture, at least in the absence of very high levels of commercial inputs. When ecologically fragile marginal lands are cultivated, they tend to become quickly eroded and infertile. When this happens, the settlers move on to clear more forest, thus repeating what is often a destructive and unsustainable process.

Soil degradation due to deforestation is most acute in tropical moist forests. Despite their lush plant growth, most tropical rainforests grow on infertile, highly acidic soils. In these ecosystems, most nutrients essential to plant growth are stored in the vegetation, not in the soil. Thus, when the forest is cleared, minerals essential to crop growth either volatilize or wash deep into the soil, beyond the reach of non-tree crops. This soon breaks the nutrient cycle, making it difficult to sustain more than 2 or 3 harvests of annual crops. The application of fertilizers as a remedial measure is usually uneconomical, because of the high cost of fertilizers and because soil conditions in many tropical areas limit their effectiveness. Moreover, with forest cover removed, the exposed ground often becomes heavily eroded; sometimes, it bakes under the tropical sun into a hard, uncultivable surface. These ecological realities were primarily responsible for the relative lack of success of Brazil's Transamazonica Highway project, designed to settle large numbers of small farmers in the Amazon region. After four years, the project was judged by Brazilian officials to be less than 7 percent successful, primarily because of unsuitable soils (NAS, 1980).

In addition to the fuelwood and other important products they supply, forests provide a wide range of "environmental services" that support economic development in such sectors as agriculture, energy, and transportation. These environmental services, such as protection of soil and maintenance of water flow patterns, are frequently overlooked or underestimated because they are

"public goods", not priced in the marketplace. Nonetheless, the loss of these environmental services through inappropriate deforestation often causes costly development failures and much human suffering. Human population growth is one of the principal forces (though by no means the only one) behind rapid deforestation in much of the developing world (Ledec, 1983; NAS, 1980).

Forests support the agricultural sector in a number of important ways. By retaining water and releasing it gradually throughout the year, forests prevent or minimize excessive flooding during rainy periods. This helps prevent the erosion of productive soils in downstream agricultural areas (World Bank, 1978). Forests also protect soils on agriculturally marginal lands, until economically viable and ecologically sustainable cropping or silvicultural techniques can be introduced. Conserving natural forests is often far less costly than rehabilitating marginal lands degraded by inappropriate clearing or subsequent misuse.

Even more importantly, forests and other well-vegetated natural areas help maintain the productivity of irrigated agriculture. By releasing water gradually on a year-round basis, they help ensure an adequate water flow to support irrigation during the dry season and prevent inundation of crops during the wet season. Furthermore, by stabilizing soils, they greatly reduce sedimentation of irrigation canals, thereby preventing the need for costly inputs of labor and capital to keep these systems functional. All told, some 40 percent of developing world farmers live in villages that depend upon the watershed functions provided by forests. Agricultural export crop production valued at \$36 billion per year depends upon the water supply and soil stabilization functions of forests (Clay, 1982).

When forests or other well-vegetated wildlands are eliminated, the damage to agricultural output can be severe. For example, the capacity of India's Nizamsagar Reservoir has been reduced from almost 900 million m<sup>3</sup> to

less than 340 million m<sup>3</sup> by sedimentation resulting from deforestation. As a result, there is now not enough water to irrigate the 1,100 km<sup>2</sup> of rice and sugar cane for which the reservoir was intended, and local sugar factories have considerable underutilized capacity (IUCN, 1980).

Aside from their provision of fuelwood, forests are important to the energy sector of developing countries by protecting and enhancing the power production of hydroelectric dams. When forests or other well-vegetated watersheds are cleared, reservoirs often become much shallower due to sedimentation. As a result, less electricity can be generated (because less water can flow through the turbines) and the useful economic life of the hydroelectric investment is shortened. For example, the useful life of the Ambuklao Dam in the Philippines has been cut from 60 to 32 years because of deforestation (USAID, 1979). Deforestation has also led to daily electricity rationing in Bogota, Colombia, by causing the Guatavita hydroelectric complex to operate at only one-sixth of normal capacity (World Environment Report, 1981). In recent years, China has built dams to add about 260 million cubic meters of new water storage capacity per year; however, about 80 million cubic meters (30 percent) are being lost each year due to sedimentation (Smil, 1983). Such losses in power generation capacity translate into impaired industrial growth or the massive expenditures required for reservoir flushing or dredging (even if practicable) or construction of replacement facilities for generating power.

Forest cover is often also important in maintaining the efficiency of the transportation sector. For example, the flood control and soil stabilization functions of forest help protect roads in mountains and high rainfall areas from being made impassable by floods and landslides, both serious problems in steep deforested areas such as Nepal and parts of

Colombia. By preventing soil erosion and the resulting sedimentation, forests and other natural areas similarly help keep harbors and navigation canals functional. Deforestation is jeopardizing the continued operation of Panama's most important economic asset, the Panama Canal, which suffers from heavy sedimentation and a lack of sufficient water during the dry season to operate the locks for the larger ships (USDS, 1978). Similarly, it costs Argentina \$10 million per year to dredge silt from the Plata River mouth and keep Buenos Aires open to shipping; 80 percent of sediment load comes from only 4 percent of the drainage basin--the small but heavily overgrazed watershed of the Bermejo River, 1,800 kilometers upstream (Pereira, 1973). In Thailand, important waterways are no longer navigable because of sedimentation resulting mainly from deforestation (Clay, 1982). The careless cutting of forests (or other forms of environmental mismanagement) can thus entail serious economic losses in maintenance expenditures, foregone revenues, and generally reduced economic activity.

Deforestation also increases the human and economic losses from natural disasters. Storms, floods, and droughts become major catastrophes when vegetation buffers are removed. For example, typhoon damage in the Philippines amounts to roughly \$20 million per year, through floods and landslides that are greatly intensified by deforestation of upland watersheds and removal of mangrove or other coastal swamps, which can buffer coastal flooding (UNEP, 1980). In China, severe deforestation and erosion in Sichuan and Yunnan provinces have been identified as important causes of record floods along the middle course of the Yangzi River in 1982 and 1983. India and Bangladesh suffer billions of dollars of property damage and tragic losses of life in annual floods of the Ganges River, made more serious by deforestation in northern India and Nepal.

SUGGESTED BOX: RECLAIMING THE HIMALAYAN WATERSHEDS

The Ganges River, which flows through India and Bangladesh, floods annually, causing millions of dollars of damage and incalculable human suffering. These annual floods are made much more severe by two types of population pressure. In the lowland areas surrounding the Ganges, population growth and competition for land has forced many people to live too close to the river, in the path of the annual floods. In the mountainous watersheds of northern India and Nepal, population growth has led to severe deforestation, causing the area's heavy rains to run off rather than soak into the soil. As testimony to the effects of population growth, the severity of flooding has increased exponentially over the past 20 years, even though the annual rainfall has remained essentially the same.

To help combat the problem, the World Bank is funding a pilot project in Uttar Pradesh State, India, to develop nine small watersheds covering 312,000 hectares. The project will attempt to reclaim denuded hillsides by establishing extensive tree plantations. To help alleviate the erosion caused by free-running livestock, stall-feeding of livestock will be encouraged. Terracing of agricultural lands will further slow runoff and erosion.

One pilot project cannot put an end to either the destruction of the Himalayan watersheds or the destructive flooding of the Ganges. But it can demonstrate a workable approach for addressing both of these problems. (END BOX).

Desertification:

Closely related to the environmental problem of deforestation in the more arid climates is desertification. Desertification is a human-caused process by which the inherent productivity of semi-arid land is lost, often irreversibly through mismanagement. The effects of desertification are often confused with those of drought. Drought results from natural fluctuation in



weather patterns; desertification results from human mismanagement of lands that are often prone to droughts. In both cases, the economic productivity of the land is reduced, sometimes to zero. However, droughts, no matter how severe, are ephemeral occurrences; when the rains return, the land's inherent productivity is fully restored. If desertification occurs, however, a return to normal rainfall can never fully restore the land's productivity. If the desertification is severe, the land may remain unproductive for many human generations, unless costly remedial measures are taken. While drought can trigger rapid desertification and can make its effects more keenly felt by those living in the affected area, most scientists agree that changes in climate are not responsible for the vast areas of semi-arid land going out of production each year (Grainger, 1982).

The economic and human losses related to desertification can be staggering. Although some 100 countries are affected by desertification, the process is most serious in sub-Saharan Africa (particularly the Sahel), southwestern Asia, and the Middle East. Every year, some 200,000 km<sup>2</sup> (an area larger than Senegal) are reduced by desertification to the point of zero economic yield (Grainger, 1982). The lost agricultural production is about US\$26 billion per year--roughly equivalent to the Gross Domestic Product of Thailand (Grainger, 1982). The human costs of desertification often include malnutrition, the threat of famine, and the dislocation involved when peasants or pastoralists must abandon their lands to seek employment elsewhere (e.g., in urban slums). The United Nations Environment Program (UNEP) Executive Director, Dr. Mostafa Tolba, wrote in 1982 that despite all efforts to control it, there is no doubt that the process of desertification actually is accelerating. More than 20 percent of the earth's surface--presently the home of 80 million people--is directly threatened by desertification (Grainger, 1982).

The proximal causes of desertification include overcultivation, overgrazing, and deforestation. All of these activities strip vegetation from the topsoil and deplete its supply of nutrients and organic matter, thereby leaving it exposed to the eroding forces of the sun and wind. The topsoil can become as dry as dust, and blow away in the wind. The remaining subsoil can become hard and impervious. It then can no longer absorb the rains when they come, and the water flows away over the surface, carrying away soil and cutting gullies which become deeper and wider year by year. In all of these situations, people are taking more from the soil than they should. They are not replacing soil nutrients, allowing the land enough time to recover under fallow, or restoring vegetative cover so that it can protect the soil from erosion. In this manner, they are consuming the land's natural capital, rather than sustainably living off the interest.

To a large extent, the proximal causes of desertification are "driven" by the pressures of rapid population growth. As rapidly expanding farmer or pastoralist populations require more food for themselves and their livestock, they frequently exceed the limited carrying capacity of semi-arid areas. When they attempt to keep production levels high during times of drought, they reduce the land's natural resilience and initiate a process of permanent degradation. Even in those situations where the existing population size is not pressing against the land's carrying capacity limits (even during dry years), a high rate of population growth makes it exceedingly difficult to control desertification. The methods needed to control desertification include grazing controls, tree planting, and improved agricultural techniques. To be effectively implemented, such activities require administrative talent and large numbers of trained personnel. Such resources, always at a premium in the developing world, become especially scarce when they are diverted to address the numerous economic, institutional, and social

adjustments that become necessary as a result of high population growth. Rapid population growth brings about the need for governments to feed or employ thousands or millions of more people each year; in the face of such pressures, longer-term problems like desertification receive insufficient attention.

Loss of Biological Diversity:

One of the irreversible consequences of today's rapid population growth is the loss of biological diversity, at a rate and scale that may be unprecedented in the history of life on earth. The best available estimates suggest that if current trends continue, some 15-20 percent of the estimated 3.5-10 million species of plants and animals alive today may become extinct by the year 2000 (CEQ, 1980; Myers, 1979; and Ehrlich and Ehrlich, 1981). The most important cause of today's species extinctions is the disappearance of the natural ecosystems upon which the species depend. Because they are naturally so rich in species, the loss of tropical forests is particularly important in reducing the earth's stock of species. As indicated above, population growth is only one of the causes of tropical deforestation (or the loss of other ecosystem types); however, it is one of the most important.

Why is biological diversity important? There are compelling ethical, aesthetic, and economic reasons for humanity to take all reasonable measures to avoid causing the extinction of other species. The ethical justification is that a growing number of people believe that human beings do not have the right to obliterate other species of living things at will--even those species not known to have any practical value to humankind. Although this ethical value is not universally shared, extinction is a completely irreversible process, and to extinguish other species is to deny the options available to all future generations of human beings. For essentially one or two generations of humans to eliminate unnecessarily a sizeable proportion of the

diversity of life on earth is, at the very least, an act of considerable arrogance. Therefore, while human society is confronted with numerous pressing short-term problems, any action with such profound and everlasting consequences as causing an extinction should also be weighed carefully.

The aesthetic justification is that many wild species of plants and animals are an irreplaceable source of wonder, inspiration, and joy to humans. This aesthetic value has only partially been translated into economic value. For example, bird watching, bird feeding, wildlife photography, and general wildlife observation accounted for expenditures of \$7-15 billion in the United States alone in 1980 (3-6 percent of GNP--U.S. Fish and Wildlife Service, 1982). However, millions of people derive enrichment merely from knowledge of the existence of many wild species they never see; this "vicarious satisfaction" has no market value.

The main economic justification for species preservation is that numerous wild plant and animal species are "undeveloped resources," in that they have major economic potential that is currently undiscovered or underutilized. Biological resources are the most essential natural resources that support human existence, and the preservation of biological diversity is important to the maintenance and improvement of agriculture, forestry, ranching, fisheries, medicine, and industry. For example, a recently discovered species of wild perennial corn (Zea diploperennis) may become of considerable importance in promoting increased food production, even though it seemed at first to be "just another weed" growing on a hillside in Jalisco, Mexico. Human society is indeed likely to be better off because this apparent weed was not eliminated by conversion of all of its natural habitat to agriculture or other uses (USDS, 1982).

Similarly, over 40 percent of all prescriptions written in the United States contain one or more drugs originating from wild species (Farnsworth, 1982). In some cases, it is impossible or more costly to synthesize these compounds than to obtain them from living sources; in other cases, it would not have been possible to know what compound to synthesize without first having the natural model.

Wild plant and animal species are also of great importance to industry, providing tannins, resins, gums, oils, dyes, and other commercially useful compounds. Even the rubber tree (Hevea basiliensis) was once just another Amazon tree species of unknown value. There is tremendous, although impossible to quantify, potential for new industrial products from currently unknown or poorly-known plant and animal species. These may even include hydrocarbons for an oil-short world: it was recently discovered, for example, that Copaifera langsdorfii, a tree that grows in northern Brazil, manufactures sap that can be used directly in diesel engines (IUCN, 1980a).

These few examples illustrate the range of economic uses of many wild plants and animals. It is important to note that 80 percent or more of all the world's species of plants and animals have never even been catalogued and given a scientific name, much less studied thoroughly for possible human uses (NAS, 1980b). Biological resources, unlike petroleum and other fossil fuels, are completely renewable, but only if care is taken not to destroy them before their value can be realized. Eliminating much of the world's vast wealth of biological diversity, because of lack of attention or short term expediency, has been likened to "burning the world's libraries for one winter's warmth."

#### Pollution and Public Health:

Although more localized and reversible than problems of natural resource degradation, pollution in developing countries can also have debilitating effects on economic development and human well-being. One of the

most important forms of pollution in LDCs is biocide abuse. While they are of considerable value (especially when used judiciously in a system of "integrated pest management"), biocides can do far more harm than good when applied excessively or without proper precautions. They destroy the natural predators of insect pests and the pollinators of crops, promote the rapid evolution of biocide-resistant insect varieties (whether crop pests or disease vectors), kill fish, and poison some 500,000 peasants each year (NRDC, 1980). A variety of industrial chemicals also kill crops and fish and damage human health in LDCs. While limited in area, urban air and water pollution in some developing country cities (such as Bangkok and Mexico City) may be so extreme as to limit economic development by choking off certain growth possibilities, forcing expensive and unwieldy industrial decentralization plans for outlying areas, and damaging the health of the urban labor force (Leonard, 1983). Another, more widespread health problem in LDCs is the mounting incidence of water-borne diseases that accompanies the construction of large dams and irrigation projects. Poor sanitation and the frequent lack of safe drinking water continue to be serious public health problems, as witnessed by the millions of children who die annually from diarrheal and other sanitation-related diseases.

These and other types of pollution can all be readily controlled, if adequate investments are made in the appropriate machinery or techniques. However, it is difficult to summon the necessary financial capital and scientific and administrative talent when these scarce resources are already stretched to their limits in managing the necessary societal adjustments to rapid population growth. Furthermore, very high urban population densities, which are in part the result of rapid nation-wide population growth, tend to concentrate pollutants, thereby making effective control more difficult and expensive.

Population Growth and the "Low-Potential Region" Phenomenon:

It is not difficult to understand that the most attractive regions for human habitation tend to be the ones that are presently the most densely settled. High-carrying capacity (or "high potential") regions tend to have fertile soils, adequate fresh water, easy access to transportation links, and abundant natural resources; they yield relatively high returns on investments made. Consequently, they attract large numbers of people and substantial investment capital. Rapid population growth, however, induces many people to move from high carrying capacity regions to those of lower carrying capacity. This can occur because employment creation does not grow as rapidly as the population, or because the existing high population density compels people to overexploit the region's natural resources, thereby overshooting (and further reducing) its carrying capacity.

Low carrying capacity (or "low potential") regions, on the other hand, are relatively poor in accessible natural resources; they may be too dry, lacking in good soils, disease-ridden, or unduly remote (thereby inhibiting trade). Investments in low potential regions yield relatively low returns; in many cases, the benefits of such investments do not exceed the economic costs. Because the costs of bringing low capacity, or "marginal," lands into production can be very high, it is economically preferable to invest in measures to reduce population growth, thereby minimizing the need to make expensive investments in expanding the carrying capacity of marginal lands. The experiences of Indonesia's Transmigration Program (see box) illustrate this point.

SUGGESTED BOX: THE CASE OF INDONESIA'S TRANSMIGRATION PROGRAM:

Indonesia, the world's fifth most populous nation, is characterized by a very uneven distribution of its population. Of the country's roughly 150 million people, some 65 percent live on Java and the smaller islands of Bali

and Madura, which together comprise only 7 percent of Indonesia's land surface. In contrast, large areas of the "Outer Islands," including Sumatra, Kalimantan (part of Borneo), Sulawesi, and Irian Jaya (part of New Guinea), are very sparsely populated. This apparent imbalance is in large measure explained by environmental factors. Java, with hundreds of volcanoes, is blessed with exceptionally fertile volcanic soils, which permit extremely intensive agriculture and sustain a rural island-wide population density of over  $600/\text{km}^2$  (up to  $2,000/\text{km}^2$  in some rural districts). On the other hand, large areas of the Outer Islands are characterized by highly infertile, acidic, thin soils that are poorly suited for intensive agriculture. As people have migrated among Indonesia's islands for centuries, it is understandable that so many have settled on Java.

Java's rapid population increase is testing the island's agricultural carrying capacity. If current trends continue, Java will have less than 0.1 hectare of land per capita by the year 2000 (Goodland, 1981). Population pressure on Java is encouraging ecologically unsound agricultural practices (e.g., cultivation of very steep slopes), which has already degraded over 23 million hectares of what the Government calls Tanah Kritis ("Critical Lands") (Goodland, 1981). Moreover, a sizable proportion of Java's labor force is unemployed or underemployed, as employment creation has failed to keep pace with population growth.

For these reasons, migration to the Outer Islands can seem attractive as a "safety valve" for Java's population growth. The Indonesian Government is conducting its transmigration program in order to move large numbers of people from Java and Bali to the Outer Islands. Since 1978, the transmigration program has entailed expenditures of roughly US\$2 billion, of which approximately US\$350 million was loaned by the World Bank.



Like many other large scale, government-assisted land settlement schemes, the transmigration program has achieved mixed results. Agricultural yields on many sites have been disappointingly low, while the economic costs of clearing and preparing the land and providing the necessary infrastructure have been high. Significant environmental costs have also occurred, including deforestation, soil degradation, and the increased incidence of malaria and other public health problems. In part because of the emphasis on settling large numbers of families quickly, the program's costs have been high--roughly US\$5,000 per family settled.

Despite the large financial investment and the high priority given by the Government to transmigration, the program has never succeeded in moving even 100,000 people per year, while Java's annual population increase is more than 2 million (Goodland, 1981). Clearly, transmigration is not a viable option for solving Java's population problem. A more important justification for the transmigration program than relieving population pressure on Java has been to promote the economic development of the Outer Islands by increasing their labor supply. However, given the difficult nature of the soils and other development constraints of the transmigration sites, the most efficient development of the areas can be obtained only through adequate advance planning and site selection. To the extent that it has provided an impetus for accelerating the program, the population pressure on Java has made such careful planning more difficult. As a result, many natural and financial resources have been wasted.

In 1966, the Government reversed Indonesia's pronatalist policies. In 1969, it launched a vigorous national family planning program. Since then, population growth on Java has fallen from 2.1 to 1.5 percent. Indonesia's family planning program has been distinguished by strong Government support and a highly acclaimed local approach that goes far beyond the more

traditional clinic system. The direct involvement of local village leaders as motivators, field workers, and even contraceptive distributors has been central to the program's success to date. The annual cost of Indonesia's family planning program from 1979 to 1983 has been roughly US\$53 million. This compares favorably with the annual costs of transmigration (approximately US\$400 million)--and the results, in terms of reducing population pressure on Java and Bali, have been far more impressive. (END BOX). Indonesia is not the only country where investments in expanding the carrying capacity of low-potential regions are not likely to be as effective as family planning in reducing population pressures in high-potential regions. Other examples of economically and environmentally costly land settlement schemes, stimulated at least in part by population pressures in high-potential areas, include the Northwest Region and Transamazonica Highway projects in Brazil, several in the Amazon regions of Peru and Colombia, Sri Lanka's Mahaweli Ganga program (see other box), Nepal's Terai settlement, and Kenya's Bura Irrigation Settlement project.

SUGGESTED BOX: CONVERGING DEMANDS ON SCARCE NATURAL RESOURCES

A growing problem in many developing nations is the competition for different products from limited land resources. Often land, whether cropland or forest land, is in short supply. Where this is the case, allocating those scarce lands among competing uses becomes a major concern.

Production of food crops faces increasing competition with energy crops for valuable land space. Energy cropping has great potential for providing fuelwood and, in some cases, liquid fuels to fuel-poor Third World nations. However, energy cropping in land-poor countries usually requires diverting land from food to non-food crops.

Establishment of fuelwood plantations requires first and foremost an investment of land sufficient for growing trees. Often such land would otherwise be used for food production. However, competition for land can be reduced if wood production can be accomplished on otherwise unused land. In South Korea, fuelwood is grown on mountain slopes of little agricultural value. The tree plantations also serve to reduce flooding and soil erosion on the steep slopes.

Social problems inherent in large-scale production of energy crops may surface first in Brazil, where such schemes are well advanced. Despite the possibility that energy crops could be produced in addition to, and not instead of, food crops, the volume of fuel required for Brazilian automobiles indicates that energy cropping might require up to one-fifth of Brazil's existing cropland, in addition to agricultural investment capital, water, fertilizer, and other inputs. Brazil may well become self sufficient in fuels, but in the process become more dependent than ever on food imports. Brazil is already the largest grain importer in the Western Hemisphere. Diversion of cropland to energy crops is likely to drive food prices up, thereby further pricing the urban poor out of the market.

Indeed, even crop and animal wastes are the object of conflicting demands. Traditionally, agricultural wastes are used for fertilizer. In heavily deforested areas, however, people may turn to burning crop wastes or animal dung instead of all-too-scarce firewood. Diversion of this resource from fertilizer to fuel use results in a loss of agricultural productivity. A generally accepted estimate holds that each metric ton of cattle dung that is burned rather than used as fertilizer means a loss of around 50 kilograms of potential grain output. Since some 400 million metric tons of dung are

annually burned in Asia, the Near East, and Africa, annual losses in potential food output total 20 million metric tons, or very roughly 15 kilograms of grain for each person in these regions.

According to a World Bank analysis, in Nepal alone the amount of dung which may be burned in the year 2000 will reduce grain production by about one million tons, or one quarter of Nepal's total annual grain production. Radical boosts in tree planting are needed to offset the deforestation which forces rural people to burn dung.

The food producing capacity of a region is lowered if land suitable for growing food is used instead for the production of firewood or other energy crops. However, both energy and food production are vital to development efforts. People must be able to cook most of the food they grow. Conversely, all the firewood in the world cannot help those who have no food to cook. Balancing conflicting demands for scarce, finite resources is a continuing challenge for sustainable development. Improved efforts to control population growth can minimize such difficult tradeoffs as these. (END BOX).

### III. Summary: Population Growth and Sustainable Development

When human populations are kept in balance with the natural resources that support them, sustainable development is possible. When human populations grow too quickly, or become too large, they damage their essential natural resource base, thereby making sustainable development impossible. In many regions, environmental stresses now indicate that the human population may be too large or growing too quickly.

Natural resources, whether renewable or nonrenewable, are inescapably finite. Thus, for developed and developing countries alike, the question is not whether there are ultimate limits to population growth. The question is which of these limits a region will encounter first, and when. If population

growth is not limited by conscious human control, it is likely to be limited by factors related to natural resource constraints.

Populations cannot be sustained beyond the carrying capacities of their regions. To develop sustainably, countries have only two viable choices. First, they can act to lower their population growth rates, through measures such as family planning. Second, they can seek to expand sustainably their carrying capacities. While both options are necessary for most developing countries to bring their populations into a sustainable balance with their natural resource base, the former option has often received insufficient attention, relative to the latter. Moreover, because carrying capacity cannot be increased forever, pursuing the second policy at best only delays the need to adopt the first.

There is also a third option--one which is not viable. That is to liquidate the capital of the natural resource base for one-time use, thereby temporarily supporting a population larger than the carrying capacity. In many areas of the world, this third option is being pursued because, in the short term, it is less costly and requires less social cooperation than either of the others. The environmental stresses and natural resource degradation described in this paper are products of this third course of action. The third option ultimately destroys a society's chances for successful, sustainable development. To be sustainable, a society must "live within its means" in terms of natural, as well as human and financial, resources.

Because of the very long "lag" periods inherent in population planning (1-2 human generations), considerable foresight capability is needed to assess possible future carrying capacity limitations and resulting environmental stresses. The existing evidence strongly suggests that many developing countries are already suffering severe problems related to environmental and natural resource degradation. Even those countries that

still have favorable population-natural resource balances are well advised to undertake vigorous population policies, because such favorable balances can easily become unfavorable within the long period required for the full effect of population policies to be felt. Aside from the question of stabilizing population size because of on carrying capacity limitations, the negative environmental consequences merely associated with a high rate of population growth provide a compelling case for urgent efforts to reduce such growth.

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SUSTAINABLE DEVELOPMENT: THE GLOBAL IMPERATIVE

The Fairfield Osborn Memorial Lecture

by

A. W. Clausen, President

The World Bank

Washington, D.C.

November 12, 1981

Good evening, ladies and gentlemen. And thank you,  
Mr. Reilly.

I am honored to deliver this year's Fairfield Osborn Memorial Lecture in Environmental Science. I believe I'm the first banker ever to be selected for this honor, which has traditionally been accorded to distinguished conservationists.

Fairfield Osborn himself, however, was a businessman -- an investment broker, who was concerned both about short-term economic development and also about its long-term sustainability.

As founder and then president of the Conservation Foundation, a cosponsor of this memorial lecture, Osborn worked until his death in 1969 to arouse the concern of people everywhere to the "...accumulated velocity with which (man) is destroying his own life sources."

In his book, Our Plundered Planet, which appeared in 1948, Osborn wrote:

"We are rushing forward unthinkingly through days of incredible accomplishment...and we have forgotten the earth, forgotten it in the sense that we are failing to regard it as the source of our life."

Fairfield Osborn insisted that the only kind of development that makes sense is development that can be sustained.

Beginning, then, from this basic premise, I'll make three main points tonight:

- first, that if our goal is sustainable development, our perspective must be global;
- second, that human development must allow for continued economic growth, especially in the Third World, if it is to be sustainable; and
- third, that sustainable development requires vigorous attention to resource management and the environment.

\* \* \*

My first main point is that if our goal is sustainable development, then our perspective must be global.

The conservation movement began in the industrial countries. But the industrial countries are linked together with the developing countries -- more than is usually recognized.

In other fora, I've made the point that the industrial countries are linked to the developing countries economically. But they are also linked environmentally.

This is obvious in the case of energy. The prospect of running down fossil fuel reserves has become a major world issue, with certain Third World countries crucial in deciding its outcome.

Other mineral resources are finite, too. And, again developing countries -- as major suppliers of many of the key minerals used by industrial countries -- will have a say in determining how these resources are managed.

Sustainable population growth is a fundamental environmental concern. By the year 2000, the world's population is likely to exceed 6 billion, with nearly 5 billion people just in the developing countries and over half of them crowded into cities.

Many of the environmental problems we tend to associate with industrial countries are also prevalent in developing countries. Urban air pollution, for example, is often worse in countries that can't yet afford even minimal controls.

But some environmental problems of world interest are concentrated in the developing countries -- deforestation,

for example. Primarily because of the growing need for firewood, Third World forests are being cut down ten times faster than new ones are being planted. As a result, planet earth has lost about a quarter of its closed-canopy forests over the last 20 years.

The developing world also has soil problems. Deforestation has contributed to severe erosion in some parts of the developing world. In tropical areas, soils tend to be especially fragile and can quickly be rendered almost useless by improper agricultural practices.

Environmental spoilation is an international cancer. It respects no boundaries. It erodes hard-won economic gains and thus the hopes of the poor.

Finally, sound development worldwide contributes to peace. And the world's conservation, in the most literal sense, may depend on peace.

In the early 1970s, when environmental concerns were approaching a peak in the industrial countries, these same concerns were met with considerable skepticism in the Third World.

Intense aspirations for development are widespread in the Third World. In many nations, economic growth is a matter of life or death for thousands of people on the margin of subsistence. Third World leaders were concerned that environmental measures not keep their peoples from fully realizing the benefits of economic growth.

Since the industrial countries consume most of the world's natural resources, concern in the rich countries about population growth in poorer countries seemed misplaced -- even sinister -- to some leaders in the developing countries.

Nevertheless, many of the world's environmental problems increasingly depend on Third World cooperation for their solution. Success on the environmental front must involve the cooperation of all sectors of the international community.

Over the last decade, the World Bank has supported the goal of achieving sustainable development on a global scale. Owned by 141 member nations, the Bank lends to Third World countries in support of their long-term development objectives. It is entirely appropriate that we not only continue but expand our efforts to insure that improvements achieved in human living conditions today are improvements that can last until we reach the tomorrows.



My second main point this evening -- that to be sustainable human development must also include economic growth -- follows from the global perspective on environmental concerns.

Even in wealthy countries, environmental protection has, to some extent, been crowded aside by priority attention to economic difficulties. Yet the world's recent economic troubles have also been particularly severe for developing countries -- and the need for economic growth in these countries is overwhelmingly compelling.

Third World leaders are absolutely right to point out that poverty is the very worst pollution that faces us on earth today.

Only about a quarter of the people who live in developing countries, for example, have access to clean water.

In the Third World, disease typically takes up a tenth of a person's potentially productive time. Disease causes suffering, dampens initiative, disrupts education, and stunts physical and mental development.

Poverty also puts severe -- and often irreversible -- strains on the natural environment. At survival levels, people are sometimes compelled to exploit their environment too intensively. Poverty has often resulted in long years of mismanagement of our natural resources, evidencing itself in overgrazing, erosion, denuded forests, and surface water pollution.

Our experience at the World Bank seems to indicate that it's much easier to deal with the negative environmental effects of development than with the negative environmental effects of pervasive and persistent poverty.

The developing regions of the world aren't all characterized by severe poverty, of course. But aspirations for a better life -- i.e., more schooling, economic opportunity, and freedom of choice -- are also powerful among the middle-income countries. In fact, aspirations for economic growth may be strongest in countries at moderate levels of income -- i.e., those countries which have enjoyed some growth over the last generation.

These hopes and aspirations are legitimate. They won't be easily denied -- nor should they be denied.

I'm encouraged that environmental concerns in Third World countries have become much more widespread over the last decade.

According to the World Environment Center, 102 developing countries now have environmental ministries or similar top-level agencies. That compares to only eleven countries in 1972, the year of the now historic United Nations Conference on the Human Environment.

You'll be interested to learn that the People's Republic of China recently established an Office of Environmental Protection. Brazil's Ministry for the Environment, established in 1972 with 3 people, now has a staff of 200. Indonesia set up an environmental ministry in 1978, to deal with its enormous problems of water supply, deforestation, erosion, and industrial pollution, and to oversee the environmental implications of its development activities.

Two notable examples of countries that now consider environmental impacts much more carefully in the process of industrialization are Kuwait and Nigeria. Venezuela, too, has made much progress in recent years, in its awareness of environmental issues and the need to take corrective and preventive measures.

It isn't that Third World countries are better able to afford environmental protection than they were ten years ago. They continue to be hard-pressed by slow growth, high energy prices, and high interest rates.

But there is increasing awareness that environmental precautions are essential for continued economic development over the long run.

Conservation, in its broadest sense, is not a luxury for people rich enough to vacation in scenic parks. It is not just a "motherhood issue."

Rather, the goal of economic growth itself dictates a serious and abiding concern for resource management. Lower income countries also -- perhaps especially -- need to think beyond the next few years.

Agriculture is the major source of income and growth in most developing countries. That's why agriculture and rural development is one of the top priorities at the World Bank. And continued agricultural productivity certainly requires protection of the natural environment.

In Africa, for example, rainfed agriculture will necessarily be the main source of increasing production for the foreseeable future. Yet the long-term potential for agriculture is being diminished -- in some countries seriously -- by overintensified cultivation and overgrazing.

In the industrial countries, we are accustomed to an adversary relationship between the goals of economic growth and environmental protection. But in the poorer developing countries, continued growth more often depends on environmental stewardship, and, conversely, a better environment more often than not depends on continued economic growth.

And so the point is that, in the Third World context, the twin goals of development and sustainability can be allied -- and must be allied. Thus, our vision of a sustainable world must realistically include economic growth, especially for those peoples who haven't yet participated appreciably in the benefits of economic growth.

\* \* \*

This brings me to my third main point -- the point I most want to stress tonight: that, in order to be sustainable, development must include vigorous and studied attention to resource management.

I want to talk about two different types of resource management -- actions to mitigate negative side-effects of development on the one hand, and positive actions to enhance the environment on the other.

Allow me, first, to review our experience at the Bank in taking precautionary measures against the negative side-effects of development.

The Bank is well-known for the thoroughness of its project preparation. And, for a decade now, the Bank has required, as part of project evaluation, that every project it finances be reviewed by a special environmental unit.

As a matter of policy, we won't finance a project that seriously compromises public health or safety; that causes severe or irreversible environmental deterioration; that displaces people without adequate provision for resettlement; or that has transnational environmental implications which are importantly negative.

Our environmental experts have reviewed more than 2,000 projects and programs in developing countries since 1970.

We've found that the cost of paying attention to environmental concerns has been much lower than many people expected when this procedure was first established. Nearly two-thirds of the projects reviewed have raised no serious health or environmental questions, and I'm pleased to say that it has been possible to incorporate adequate protective measures in all the projects we have financed during the past decade.

The cost of these environmental and health measures has proved not to place an unacceptable burden on our borrowing countries. And we've learned, as have many private corporations, that the cost tends to be lower the earlier that environmental problems are identified and handled.

We're convinced that it's almost always less expensive to incorporate the environmental dimensions into project planning than to ignore them and pay the penalties at some future time.

It costs a lot less, for instance, to protect the forested watershed above a new dam than to deal with a silted reservoir after it's been built. Similarly, the benefits of an irrigation project can be diminished if, for lack of proper planning, it leads to an increase of schistosomiasis.

We're financing an increasing number of projects to rectify undesirable side-effects of past development. We are working with the Mexican authorities, for instance, on various environmental problems, including air and water pollution in Mexico City. In Kenya, we're financing a wildlife management project. We're also involved in helping Nepal deal with its dramatic problems of deforestation and soil erosion.

In the Sahel region, we've financed a series of projects designed to halt the expansion of the desert and, more recently, to also reclaim desertified land by providing shelter belts of restored forest cover.

On the basis of the Bank's experience in trying to anticipate environmental problems associated with development, we've published extensive checklists, handbooks, and guides for different types of projects -- to help Bank staff and

planners around the world think through all the identifiable effects of development projects.

But in addition to telling you about some of the protective and corrective efforts, which are being made in Third World countries, I also want to speak about positive efforts to enhance the environment. Although environmentalism tends to be identified with precautions in development, I believe that some of the most effective environmental efforts are those that achieve development and sustainability at the same time.

Let me briefly describe three sectors where the goals of economic development and environmental enhancement coincide.

Improving systems of water supply and waste removal is one obvious area in which we can enhance the environment through development.

Our lending programs in water supply and waste disposal have increased from an annual average of \$300 million in the mid-1970s to more than \$700 million currently.

We are emphasizing economical technologies (such as standpipes or hand pumps for water, and septic tanks or latrines for sanitation), since they cost a fifth to a tenth as much as piped systems -- and thus make it possible to improve the living environment of more families given the constraints of limited government budgets.



Rapid urbanization is going to continue throughout the developing world, even if vigorous rural development and population policies are adopted. We expect that the urban population of the Third World will continue to grow about twice as fast as the rural population over the next 20 years. And growing cities, if not properly managed, pose special environmental problems -- especially water and waste disposal problems among the poor.

So we also have an active program of investment in urban infrastructure. Our purpose is not simply to help public authorities cope with current urban growth, but rather to introduce appropriate technologies -- and to develop institutions that are better able to cope, on a continuous basis, with burgeoning city growth in the Third World.

A second sector where environment and development directly interface is energy. This area, along with agriculture and rural development, demands the highest priority among the many activities of the Bank.

In addition to rapidly expanding our lending to accelerate the development of hydro and fossil fuel resources, the World Bank is also encouraging energy conservation and the development of renewable energy sources.

Energy conservation has become a major theme in our dialogue with borrowing governments about their development strategies, because energy imports now represent a heavy financial burden for those developing countries which are not sufficiently self-reliant for their own growing energy requirements.

With regard to renewable energy sources, we attach high priority to forestry.

While rising oil prices have captured the headlines, for almost half the world's population energy problems take the form of a daily search for firewood with which to cook.

The World Bank has embarked on a vigorous expansion of its forestry program. Our average annual lending for forestry projects over the last four years has been six times what it was in the previous four years.

Two of our successful forestry projects (one in Korea and another in India) supported programs which emphasized public education to encourage tree-planting.

In Burundi -- where deforestation around the capital city has forced many low-income families to spend 40% of their incomes on firewood and fuel -- the Bank has financed a promising program to introduce improved cooking stoves. Traditional stoves waste as much as 90% of the heat they generate, and open fires are even less efficient.

In addition to our concern about forestry and firewood, the Bank has also been exploring new ways that developing countries can increase the amount of energy they get from other renewable sources: through the production of alcohol, for example, or -- over the longer-term -- by taking advantage of the abundance of sunshine with which much of the developing world is blessed.

The developing countries already depend on traditional biological sources for a quarter of their energy requirements. And we think they can substitute renewable sources for another five to fifteen percent of their energy needs before the end of this century.

Finally, a third area, in addition to water supply and waste removal and energy, where the goals of economic development and environmental protection coincide is population planning.

We now know that, although family planning programs help, the most effective way to moderate population growth is to alleviate poverty and to provide improved health care.

Population growth rates in the Third World began to drop in the mid-1960s. Birth rates have declined at least 10% in the world's two most populous countries, China and India. Birth rates have also declined in Indonesia, Turkey, and in most of the middle-income countries of Latin America and East Asia.

Quantitative analysis suggests that social and economic improvements (such as higher incomes, literacy and life expectancy) accounted for as much as 60% of the variation in fertility among developing countries from 1960 to 1977. The strength of family planning programs explained an additional 15%.

The World Bank remains committed to supporting development efforts that assist the poor to become more economically productive. We continue to invest significantly in rural development, education, health, and family planning.

One of the dividends of this whole range of investment -- beyond the benefits to the families who are helped directly -- will be a more rapid shift to a sustainable pattern of global population growth.

Well, ladies and gentlemen, these are just a few examples of development which obviously contributes to long-term sustainability as well as to short-term benefits. But, as a matter of fact, we think that all development can enhance the conditions in which we live.

When we finance agricultural development, measures are taken both to develop existing resources and also to protect those resources for the future. When we invest in industry,

given proper precautions, increased production means higher incomes which workers can use to improve the quality of their environment and the lives of their families.

Our mandate is economic development, and development, of necessity, involves changing the natural and social environments. But with due attention to resource management, all economic development should, on balance, improve people's environment, in the broad sense of the word. That is, after all, the fundamental purpose of development.

\* \* \*

Fairfield Osborn was a great admirer of Theodore Roosevelt. A generation before Osborn, during a formative period of economic development in the United States, President Roosevelt argued that conservation was essential to the long-term economic growth of this country. He said:

"The Nation behaves well if it treats the natural resources as assets which it must turn over to the next generation ... Conservation means development as much as it does protection."

Today our perspective must be global, and our concern for the environment must be even more urgent than in Roosevelt's time. And his words are still true. That concern is an essential ingredient of development.

The international development community must face that fact with realism and sensitivity.

And I ask you who are ardent defenders of the environment to join efforts with those of us who are trying to assist the developing countries accelerate their economic growth and improve the quality of life of their societies.

All of us in this room -- and all around the world who identify themselves primarily either with the international development community, or with the international conservation movement -- ought to be more partners than partisans.

For sustainable development, and wise conservation are, in the end, mutually reinforcing -- and absolutely inseparable -- goals.

Thank you very much.

AN ANNOTATED BIBLIOGRAPHY OF

ENVIRONMENTAL ECONOMICS

Office of Environmental Affairs  
The World Bank  
1981

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## Introduction

The intimate relationship between the resources of the natural environment and the operation of economic systems has gained increasing recognition during the last half century. It is now more or less accepted wisdom that environmental resources provide important services as productive inputs, waste assimilators, and consumption goods. Water, for example, serves as an input in agriculture and industry, as a waste assimilator for industry and urban areas, and when pure or purified, as a product for human consumption. The allocation of environmental resources among these and other competing uses is the subject of environmental economics.

Because environmental resources and the services of natural systems rarely pass through markets, they appear to be free and are therefore often utilized over and above economically and ecologically optimal levels. The costs of overutilization are frequently borne elsewhere in the economy and are thus referred to as externalities. Some form of public regulation may be necessary to correct the misallocation of environmental resources. The field of environmental economics covers both resource optimization as well as efficient regulation. Some of the questions which are addressed include:

- o What is the socially optimal allocation of environmental resources?
- o What is the appropriate level of pollution abatement?
- o Which technologies and policies are most cost-effective?
- o In which areas should research and technological improvements be concentrated?
- o Does the capacity of the natural environment to assimilate wastes impose ultimate limits on economic growth?
- o What are the implications of these issues for developing countries?

The purpose of this bibliography is to provide the staff of the World Bank and others who are engaged in development project planning with a list of materials which address such questions. The emphasis here is on economics: that is, the theory and techniques of evaluation and optimization. Economic analysis of environmental resources must, of course, make use of data provided by other disciplines. The science of ecology and the techniques of environmental impact assessment are of particular importance, but works dealing primarily with those disciplines have not been listed here.

Because the field of environmental economics is fairly new, some aspects of the subject have been developed more fully than others. Moreover, economists disagree in several areas of both theory and application. The works listed here reflect both the unevenness and the lack of consensus.

Although an effort has been made to find works which are relevant to the environmental conditions and economic problems of the developing countries, particularly in those sectors in which the World Bank is involved, the vast majority of the writings listed here were undertaken by individuals and organizations in the developed countries. The lack of materials on the practical application of environmental economics in the developing countries is probably a reflection not only of the relatively more heightened public awareness in the developed countries, but also of the general lack of resources for such research in the developing countries. It could also reflect our failure to discover some existing works. We are continuing our search.

This bibliography has been divided into four parts. Part I lists materials which provide a broad introduction to the field. These include basic works on the theory of externalities, books which provide an overview of the field, and literature surveys.

Part II, the main body of the bibliography, enumerates studies of the theory and techniques of environmental economics. This literature deals with the problem of assigning values, or weights, to the costs of environmental damage (i.e. the benefits of protection) and analyzing the costs of protection. Throughout, a major concern is the optimization of environmental protection in light of the costs and benefits. Works which deal with techniques in a general manner are listed in Section A. Many of the remaining materials in Part II include empirical data or case studies. These have been classified on the basis of content. The works enumerated in Section B deal with regional environmental management which encompasses all types of activities and environmental media. Section C includes studies of the problems associated with particular productive sectors. The focus here is on the sectors in which the World Bank is involved through its lending activities. Thus, nothing on the subject of nuclear power has been included. Likewise, there is very little on the evaluation of tourist or recreation facilities. The studies listed in Section D do not deal with particular sectors but rather with the effect of pollution from multiple sources on ambient air quality, human health, buildings, and equipment. The final section of Part II contains works on the allocation and efficient use of resources. Because there is some overlap in the classification scheme used in Part II, a few cross references have been included.

Part III covers policy issues and the mechanisms for regulating environmental quality. General treatments of policy issues and the role of government are listed in Section A. Section B enumerates several empirical studies of the macroeconomic effects of large scale pollution control programs. Effects on employment, inflation, trade, GNP growth, etc. are reviewed. Section C includes works in which the effectiveness of various policy mechanisms is analyzed and proposals for improvement are made. The distributional effects of both pollution itself and protection programs is the subject of the works listed in Section D. Section E includes materials on the international economic implications of environmental protection and on the evaluation of international policies and institutions.

Part IV lists works representing different points of view on growth and the limits to growth.

It is hoped that this bibliography will be useful both to those who are designing overall development strategies as well as to those who are planning and appraising projects. The former group will find the following sections particularly relevant: in Part II: B. Regional Models for Environmental Management, and E. Resource use; all of Part III; and Part IV. Project planners might find the following most useful: in Part II: A. Welfare Economics and Techniques of Analysis, C. Sectoral Studies, and D. Non-Sectoral Evaluation of Pollution Effects.

Most of the works listed here are available to World Bank staff. Many can be found in the Joint Bank-Fund Library. Several are listed in Documentation Available to Staff, and a few are available in the library of the Office of Environmental Affairs.

Abbreviation: The abbreviation Bibl. at the end of an entry indicates that the work includes a bibliography or a list of further readings.

## I. Introductory Works

The materials enumerated in this section provide an introduction to both the theory and application of environmental economics. A wide range of topics are covered. In the theoretical works, the applicability, non-applicability, and inadequacy of general principles of economics for dealing with environmental effects are explored. Some of the works include examples of applications. A variety of domestic and international policy issues are also discussed. The surveys and bibliographies serve to supplement this bibliography and provide historical background.

### I.A. Textbooks and Other General Works

Dorfman, Robert, and Nancy S. Dorfman, eds. Economics of the Environment, Selected Readings. New York: W.W. Norton and Co., 1972. 426 p. Bibl.

A collection of essays and articles on topics such as: methods of analysis, the growth controversy, and policy mechanisms. Two articles on benefit-cost analysis demonstrate how the technique can be applied to the human health effects of air pollution and the recreational benefits of environmental improvement. There is also an article on Leontief's input-output technique for estimating the pollution costs of outputs.

Edel, Matthew. Economics and the Environment. Englewood Cliffs, New Jersey: Prentice-Hall, 1973. 162 p.

This fairly elementary and inexhaustive approach to the subject includes several illustrative examples from developing countries. The problems of ecological damage due to food production and automotive pollution are treated. A middle ground on the growth issue is proposed. GNP as a measure of welfare is discussed.

Herfindahl, Orris C., and Allen V. Kneese. Quality of the Environment, An Economic Approach to Some Problems in Using Land, Water, and Air. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1965. 96 p. Bibl.

Intended for economists as well as non-economists, this book outlines the contribution that economics can make toward solving environmental problems in five areas: water, air, chemical pesticides, and urban and rural environments.

Jarrett, Henry, ed. Environmental Quality in a Growing Economy.  
Baltimore: Johns Hopkins University Press, for Resources for the Future,  
1966. 173 p.

A collection of essays on six facets of the subject: resource develop-  
ment, human health, externalities, research goals, public attitudes, and  
policies and institutions.

Kapp, K.W. "Environmental Disruption and Social Costs: A Challenge To  
Economics." In Political Economy of Environment: Problems of Method.  
The Hague: Mouton, 1972. pp. 91-124.

Questions the adequacy and current relevance of the existing framework of  
economic analysis.

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. The Social Costs of Private Enterprise. New York: Schocken  
Books, 1971. (Originally published by Harvard University Press, 1950).  
287 p.

This critique of accepted economic theory and practices was first  
published in 1950 and has become a classic on the subject of externalities.  
Kapp demonstrates how the maximization of net income by private enter-  
prise results in environmental and socio-economic costs, such as illness,  
pollution, and depletion of resources, which must be borne elsewhere in  
the economy. He espouses the development of a broader system of economic  
analysis which would account for such costs.

Maler, Karl-Goran. Environmental Economics: A Theoretical Inquiry.  
Baltimore: Johns Hopkins University Press, for Resources for the  
Future, 1974. 280 p.

Presents a conceptual model which links macroeconomic concepts with a  
materials balance approach.

Pearce, David W. Environmental Economics. London: Longman, 1976. 202 p.

Presents the theory of externalities within a welfare economics framework.  
Among the topics discussed are: the use of input-output techniques for  
analyzing materials flows and environmental impacts; determination of the  
optimal level of pollution; the use of Pigovian taxes; comparative  
effectiveness of standards and taxes; and the limits of cost-benefit  
analysis.

Pearson, Charles; and Anthony Pryor. Environment North and South, an Economic Interpretation. New York: John Wiley and Sons, 1978. 355 p.

Explores the relationship between environmental conditions and economic growth in the developing countries. Addresses international environmental issues and their implications for developing countries. Of particular interest are the chapters on project appraisal and agriculture. Basic economic theory relevant to each topic is presented. A great deal of demographic, economic, and environmental data are presented in tables.

Wingo, Lowdon, and Alan Evans, eds. Public Economics and the Quality of Life. Baltimore: Johns Hopkins University Press, for Resources for the Future and the Centre for Environmental Studies, 1977. 327 p.

A collection of 15 papers in which various dimensions of the term "quality of life" are defined and analyzed. Among the topics which are covered are: the quality of life in cities, in the working environment and among the elderly, problems of measurement, the role of governments, the limits of cost-benefit analysis, the relationship between property values and the quality of life, and the treatment of externalities in national income accounts.

#### I.B. Surveys and Bibliographies

Field, B.C., and C.E. Willis. Environmental Economics: A Guide to Information Sources. Detroit, Michigan: Gale Research Co., 1979. 243 p. Bibl.

An annotated guide which focuses on the U.S. but includes a few European Publications in English. Part I lists theoretical works and Part II concentrates on empirical studies. Author, title, and subject indices.

Fisher, Anthony C., and Frederick M. Peterson. "The Environment in Economics: A Survey." Journal of Economic Literature, XIV:1 (March 1976) pp. 1-33. Bibl.

Reviews the literature and traces the development of thinking in two broad areas: alternate uses of non-renewable natural environments, and the capacity of the environment to assimilate pollution.

Mishan, E.J. "The Postwar Literature on Externalities: an Interpretative Essay." Journal of Economic Literature, IX:1 (March 1971) pp. 1-28. Bibl.

A review of the theory of externalities with an emphasis on its application to public goods and the environment.

## II. Evaluation of Costs and Benefits

This section includes works in which the theory and techniques for evaluating environmental effects are described and demonstrated. This literature deals with the problem of assigning values to environmental damages and analyzing the costs of protection. A major concern is the optimization of environmental protection in light of the costs and benefits. Many of these works are in the form of reports on research and development of new techniques. Most include case studies or hypothetical examples. For additional recent literature on evaluation techniques, readers should also consult the Journal of Environmental Economics and Management.

### II.A. Welfare Economics and Techniques of Analysis

In this section, general works on the theory of welfare economics and techniques of evaluation are listed. Benefit-cost analysis, cost-effectiveness techniques and other methods of estimating environmental costs and benefits are covered.

Abelson, Peter. Cost-Benefit Analysis and Environmental Problems.  
Westmead: Saxon House, 1979. 202 p.

This work has two parts. In the first part, the nature of environmental problems and the usefulness of cost-benefit analysis are treated. The second part is a demonstration of the application of cost-benefit analysis in five environmental case studies. The case studies are based on Australian experiences in soil conservation, sand mining, airport location, aircraft noise, and amenity valuation.

Cooper, Charles. Economic Evaluation and the Environment, a Methodological Discussion with Particular Reference to Developing countries. Sponsored by the United Nations Environment Program. London: Hodder and Stoughton, 1981. 161 p.

A critique of techniques for evaluating environmental impacts. Discusses practical problems, objectivity, discount rates, risk and uncertainty, and alternatives to cost-benefit analysis such as ranking methods.

Development Planning and Research Associates, Inc., ICF Incorporated, T. Watson Noah Associates, Inc., and Battelle Memorial Institute. Cost-Effectiveness Framework for Minimizing Total Cost of EPA Regulations. Phase 1 Report prepared for the U.S. Environmental Protection Agency, Jan., 1979. 90 p.

Report on the development of a marginal cost-effectiveness methodology and its application in two industries: textiles and coal fired power plants. An attempt is made to establish the relationship between successively more stringent degrees of abatement and the corresponding change in costs. The incremental (non-marginal) nature of data and the allocation of costs when the abatement process affects more than one pollutant are among the problems which are addressed.

East-West Environment and Policy Institute. Benefit-Cost Analysis of Natural Systems and Environmental Quality Aspects of Development. Honolulu: East-West Center, 1981. (prepublication draft).

This report is intended for use primarily as a training manual for planners and analysts of development projects and programs. An introductory chapter discusses basic theory and concepts. In the second chapter, the locus of environmental quality evaluation activities within the institutional framework of developing countries is discussed. The potential interplay between project planning and national, regional, and sectoral planning with regard to environmental quality and natural systems is explored. Most of the remainder of the manual is devoted to descriptions of techniques of evaluation and detailed examples of applications. The East-West Center is also developing a set of case studies to be used with the manual.

Freeman, A. Myrick. The Benefits of Environmental Improvement: Theory and Practice. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1979. 288 p. Bibl.

Reviews the theory as well as the methodologies and empirical techniques which have been developed on the basis of the theory. The channels through which environmental changes are felt have been listed and categorized on the basis of whether they are living systems or non-living systems. Techniques for assigning values to the effects in each category are described. The author suggests how the techniques can be applied and identifies areas requiring further research.



Maler, Karl-Goran, and Ronald E. Wyzga. Economic Measurement of Environmental Damage, a Technical Handbook. Paris: OECD, 1976. 151 p.

Various methods of estimating the monetary value of physical damages are reviewed; guidelines for their practical application are provided. Techniques of estimating direct financial losses as well as amenity losses are included.

Mishan, Ezra J. Cost-Benefit Analysis. New and expanded edition. New York: Praeger, 1976. 454 p.

Of relevance are Part III, in which Mishan discusses internalization of externalities, and Part IV, in which problems of evaluating pollution costs, health effects, etc. are discussed.

Odum, Eugene P. "Bionomics." In Ecology, the Link Between the Natural and the Social Sciences, 2nd ed. New York: Holt, Rinehart and Winston, 1975. pp. 216-219.

Compares alternative ways of evaluating the services of natural environments. Proposes the use of energy units instead of monetary units for valuing natural environments.

Pearce, David W. "The Limits of Cost-Benefit Analysis as a Guide to Environmental Policy." Kyklos, XXIX:1 (1976) pp. 97-112.

Pearce argues that economically optimal levels of environmental damage may lead to ecological breakdown.

\_\_\_\_\_, ed. The Valuation of Social Cost. London: Allen and Unwin, 1978. 198 p.

This volume presents both theory and practice. An introductory chapter outlines the characteristics of social, as opposed to private, costs. Further chapters elaborate on specific techniques for evaluating noise nuisance, air pollution, etc. A final chapter deals with the problem of incorporating social costs into national accounts.

United Nations Environment Program. "A Framework for the Design of Future Case Studies on the Application of Cost Benefit Analysis to Environmental Protection Measures." Paris: UNDP, 1979. 67 p. Bibl.

Outlines a conceptual structure for the preparation of case studies of environmental control measures. Presents a set of categories in which costs and benefits should be evaluated and compared. Methodologies such as cost-effectiveness and risk-benefit analysis are examined. The role of benefit-cost analysis in the management and planning process is addressed.

Victor, P. Economy and Environment. London: Allen and Unwin, 1972. 247 p.

Input-output tables and a system of relative weights are applied to pollutants in order to determine which activities are most costly ecologically.

II.B. Regional Models for Environmental Management (see also II.C.I. Agriculture, Forestry, and Fisheries)

Regional environmental quality management is an integrated multi-sectoral approach to analyzing a variety of natural systems and environmental effects within a region. In the following works, research in this relatively new field is reported.

Basta, Daniel J., James L. Lounsbury and Blair T. Bower. Analysis for Residuals-Environmental Quality Management: A Case Study of the Ljubljana Area of Yugoslavia. RFF Research Paper R-11. Washington: Resources for the Future, 1978. 256 p.

The authors suggest a framework within which they believe decision makers in widely different kinds of societies can approach the problem of environmental quality management. This includes an analysis of the flows of materials and energy in the many activities distributed over a region, and an evaluation of the environmental quality impacts and of the opportunities and costs of alternative strategies to achieve different levels of environmental quality. Particular attention is paid to local conditions, needs, and resources.

Bower, Blair, ed. Regional Residuals Environmental Quality Management Modeling. RFF Research Paper R-7. Washington, D.C.: Resources for the Future, 1977. 244 p.

Presents the results of an international collaborative effort to develop regional residuals-environmental quality management (REQM) methodologies which compare the costs and impacts of alternative levels of pollution abatement for a defined region. This research report provides an overview of REQM and of the analysis necessary to generate the necessary data. It includes four illustrative regional case studies of the application of REQM in the U.S., Yugoslavia and Czechoslovakia.

Kneese, Allen V., R. U. Ayres, and Ralph C. d'Arge. Economics and the Environment, A Materials Balance Approach. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1970. 120 p.

This book was the first published report on RFF's research on the management of residuals and of environmental quality. The proposed approach treats air, water and solid waste problems in an integrated system rather than as separate categories.

Kneese, Allen V., and Blair T. Bower. Environmental Quality and Residuals Management: Report of a Research Program on Economic, Technological, and Institutional Aspects. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1979. 352 p. Bibl.

The research reported here was aimed at illuminating the interrelationships among liquid, gaseous, and solid wastes, as well as the dynamics of time and place of emission. Environmental policies and institutional arrangements for taking these relationships and dynamics into account are proposed. The book encompasses analysis at three levels: the micro or plant level, the regional level, and the macroeconomic level. The presentation is expository; a set of appendices provide selected mathematical methods and proofs.

Russell, Clifford S., and Walter O. Spofford, Jr. "A Quantitative Framework for Residuals Management Decisions." In Allen V. Kneese and Blair T. Bower, eds. Environmental Quality Analysis: Theory and Method in the Social Sciences. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1972. pp. 115-179.

Description of a regional environmental quality model which combines models of industrial output, pollution discharge, environmental diffusion, and receptor-damage functions.

Russell, Clifford S., and Walter O. Spofford, Jr. "A Regional Environmental Quality Management Model: An Assessment." Journal of Environmental Economics and Management, IV:4 (1977) pp. 89-110. (RFF Reprint 147)

The authors discuss the research and policy lessons learned from a large regional environmental quality management model which was used to estimate the costs of meeting varying standards for air and water quality in the Lower Delaware River Valley Region of the U.S.

Spofford, Walter O., Jr., Clifford S. Russell, and Robert A. Kelly. Environmental Quality Management/an Application to the Lower Delaware Valley. RFF Research Paper R-1. Washington: Resources for the Future, 1976. 204 p.

## II.C. Sectoral Studies

The works listed here treat environmental problems which are associated with particular economic activities. A major concern is the problem of optimizing environmental quality in light of the costs and benefits of control. For the convenience of World Bank staff, these materials have been categorized in sectors which correspond to World Bank lending activities.

### II.C.1. Agriculture, Forestry, and Fisheries

Clawson, Marion. The Economics of National Forest Management. RFF working Paper N-6. Washington: Resources for the Future, 1976. 126 p.

The author analyzes the output of U.S. national forests and makes suggestions for increasing the efficiency of forest management. The inadequacies of price policies and the problems caused by free use of forest products are emphasized.

Crutchfield, James A., and Giulio Pontecorvo. The Pacific Salmon Fisheries: A Study of Irrational Conservation. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1969. 232 p.

In an attempt to discover why public management of Salmon fisheries in the U.S. resulted in the decline of this industry, the authors found that management had been strictly based on biological rather than economic criteria. A program of public regulation based on both biologic and economic criteria is proposed.

Food and Agricultural Organization. Economic Evaluation of Sport and Commercial Fisheries. EIFAC Technical Paper 26, 1977.

\_\_\_\_\_. Groundwater Pollution: Technology, Economics and Management.  
FAO Irrigation and Drainage Paper 31, 1979. 137 p.

Causes and types of groundwater pollution are identified. Monitoring and control technologies are described. Among the topics covered are: the economic concept of externalities; the interaction between technical, institutional and economic factors; financial aspects of pollution control; methods of analyzing costs and benefits; and the use of optimization models, input-output analysis and simulation techniques. A case study of alternative water supply plans for the Valencia Plain Area of Spain is presented.

Frederick, Kenneth D. Water Management and Agricultural Development: A Case Study of the Cuyo Region of Argentina. Baltimore: The Johns Hopkins University Press, for Resources for the Future, 1975. 204 p.

The author points out that government policies and subsidies have resulted in an inefficient allocation of scarce water resources in the Cuyo Region. Policy options which would ensure the continued productivity of agriculture are proposed. Problems such as the adjustment of marginal farmers to higher costs of water are addressed.

Headley, J.C., and J.N. Lewis. The Pesticide Problem: An Economic Approach to Public Policy. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1967. 160 p.

The authors review the benefits and costs of pesticide use and develop a conceptual decision framework for explicit and systematic consideration of the issues. Lack of complete data makes a full evaluation impossible.

Langham, Max R., Joseph C. Headley, and Frank W. Edwards. "Agricultural Pesticides: Productivity and Externalities." In Allen V. Kneese and Blair T. Bower, eds. Environmental Quality Analysis: Theory and Method in the Social Sciences. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1972. pp. 181-212.

Two empirical studies of pesticide use are described and an attempt is made to include externalities in a benefit-cost analysis.

## II.C.2. Energy

Krutilla, John V. et al. "Observations on the Economics of Irreplaceable Assets." In Allen V. Kneese and Blair T. Bower, eds. Environmental Quality Analysis: Theory and Method in the Social Sciences. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1972. pp. 67-112.

The authors discuss the theory of option value and its relevance to resource allocation decisions. The suggested methods are applied to proposals for hydroelectric development of Hells Canyon in the U.S.

Organization for Economic Cooperation and Development. The Costs and Benefits of Sulphur Oxide Control - A Methodological Study. Paris: OECD, 1981. 164 p. Bibl.

Presents a methodology for estimating the costs and benefits of controlling emissions of sulphur oxide pollutants from oil and coal power stations. Energy forecasts for OECD countries and a set of control scenarios are used to estimate costs and benefits to the year 1985. In spite of inadequate data, it is shown that costs and benefits are roughly in balance.

Rosenfield, Patricia. The Management of Schistosomiasis. RFF Research Paper R-16. Washington: Resources for the Future, 1979. 148 p.

Provides planners with a methodology for considering the possibility of schistosomiasis transmission and for planning control techniques during the early stages of a project. Control measures are analyzed in terms of costs and benefits. The techniques are applied to the Volta Lake Development Project in Ghana.

University of Wisconsin Energy Systems and Policy Center; Environment and Policy Institute, The East West Center; Ministry of Mines and Energy, Indonesia; Korean Energy Research Institute; and Ministry of Energy, the Philippines. Planning and Management of Energy/Environment Systems in Asian-Pacific Countries: A Planning Document. 1980. 51 p.

Background and plans for a three-year program of cooperative research on energy options and their environmental implications. Development of analytic tools for evaluating alternative options is planned.

### II.C.3. Industry (see also II.B. Regional Models for Environmental Management)

Atkins, M. H., and J. K. Lowe. The Economics of Pollution Control in the Non-ferrous Metals Industry. Oxford: Pergamon Press, 1979. 177 p.

An investigation of pollution control costs and the relative efficiency of different control technologies in the aluminium, copper, brass, zinc, and metal founding industries. Emphasis is placed on the experience of industries in the U.K., with some reference to other European countries and the U.S. The effects on cost levels of different production conditions and the timing and degree of pollution control are addressed.

An attempt to evaluate alternative levels of emission control. The methodology is similar to that used for the iron and steel study: an effort has been made to identify each unit operation, each distinct emission control technology, and the emissions levels associated with them. A great deal of data are presented in tables. The problem of separating production costs from emission control costs is addressed.

Industry. Paris: OECD, 1977. 151 p.  
Pollution Control Costs in the Primary Aluminum

On the basis of data provided by five OECD countries (Belgium, Finland, France, Sweden, and the U.S.) conclusions have been drawn about emissions control costs at the unit operation level. Costs have been calculated for three broad product categories and for three different levels of pollution control. Observations are made on the variation in costs among countries, potential trade effects, and the cost of retrofitting vs. the cost of control measures in new plants.

Paris: OECD, 1977. 175 p.  
Emission Control Costs in the Iron and Steel Industry.

This report provides statistical data on alternative levels of emissions control in the various production processes of the fertilizer industry. Site specific costs are discussed. The extent to which costs are affected by changes in capacity utilization and the scale of operations is also explored.

Organization for Economic Cooperation and Development. Emission Control Costs in the Fertilizer Industry. Paris: OECD, 1977. 156 p.

Experts from several countries discuss methodology, applications, and the effectiveness of policies in several industrial sectors.

the United Nations Environment Special Issue No. 2, 1981. (Published by the United Nations Environment Program) 22p.  
"Cost-Benefit Analysis: A Tool for Sound Environmental Management."

An assessment of the effects of changes in production processes and paper quality on the generation rates of selected residuals. A total of eleven residuals are considered: five gases, four liquids, and two solids.

Natural Resources Journal, 11:4 (Oct., 1971) pp. 605-623.  
Bower, Blair T., George Lof, and W.M. Hearon. "Residuals Management in the Pulp and Paper Industry."

. Waste Paper Recovery - Economic Aspects and Environmental Impacts. Paris: OECD, 1979. 160 p.

An evaluation of the costs and benefits of low-grade waste paper recovery with special attention to pollution and energy impacts. Major obstacles to recycling, problems of market fluctuations, and international trade issues are also considered.

Royston, Michael G. Pollution Prevention Pays. Oxford: Pergamon Press, 1979. 197 p.

Pollution prevention refers to methods of eliminating the causes of pollution, rather than cleaning it up once produced. It also refers to the creation of useful products from wastes, as well as the conservation of resource inputs. Royston describes some pollution prevention and resource recovery technologies which have resulted in higher profits for industries. He discusses the ways in which environmental regulations may encourage or discourage pollution prevention.

Russell, Clifford S. Residuals Management in Industry: A Case Study of Petroleum Refining. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1973. 193 p.

An industrial model for analyzing the costs of alternative residuals management policies is applied to a hypothetical petroleum refinery. The model allows for the simultaneous consideration of gaseous, liquid, and solid wastes, and can reflect changing patterns of input costs and output quantity and quality.

Russell, Clifford S., and William J. Vaughan. Steel Production: Processes, Products, and Residuals. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1976. 348 p.

This study presents a linear programming methodology for investigating the effects that alternative public policies have on industrial costs and resource use. The methodology has been applied to the steel industry and has generated data on the environmental control and resource use problems of that industry.



II.C.4. Transportation

Watson, Peter L. World Bank Experience with Road Pricing Schemes.  
Prepared for OECD Seminar on Urban Transport and the Environment,  
Paris, 1979. 23 p.

Describes the implementation of road user charges for the purpose of reducing congestion and air pollution in Singapore, Kuala Lumpur and Bangkok. Reviews costs, benefits, problems encountered and lessons learned.

II.D. Non-Sectoral Evaluation of Pollution Effects

The following works deal with the effects of pollution from a variety of sources. The primary focus here is on evaluating the benefits of environmental protection, i.e., the cost of environmental damage.

II.D.1. Effects of Air Pollution (see Also II.D.2. Health Effects and II.D.3. Damage to Materials)

Ridker, Ronald. Economic Costs of Air Pollution. New York: Praeger, 1967.

II.D.2. Health Effects

Carpenter, B. H. et. al. Health Costs of Air Pollution Damages: A Study of Hospitalization Costs. U.S. EPA Technical Report Data. Washington: EPA, 1977.

Crocker, T. D., W. Shultz, S. Ben-David, and A. V. Kneese. Methods Development for Air Pollution Control Benefits. Experiments in the Economics of Air Pollution Epidemiology, Vol. 1. Washington: U.S. Environmental Protection Agency, Feb. 1979.

Gregor, J. J. Intra-Urban Mortality and Air Quality: An Economic Analysis of the Costs of Pollution-Induced Mortality. U.S. EPA Technical Report Data. Washington, EPA, 1977.

ICF Incorporated. Feasibility of Measuring and Comparing the Cost-Effectiveness of EPA Regulatory Efforts to control Toxics-Related Health Risks. Washington: ICF, 1981.

An attempt to develop methods for cost-effectiveness analysis of policy alternatives when the costs and benefits are not necessarily monetized. Positive and negative outcomes of regulatory programs are compared in their natural units. Case studies of five EPA regulations are presented: lead in ambient air, lead and lead compounds in navigable waters, lead in drinking water, vinyl chloride emissions, and chlorofluorocarbons used as aerosol propellants.

Lave, Lester B. "Air Pollution Damage: Some Difficulties in Estimating the Value of Abatement." In Allen V. Kneese and Blair T. Bower, eds. Environmental Quality Analysis: Theory and Method in the Social Sciences. Baltimore: John Hopkins University Press, for Resources for the Future, 1972. pp. 213-242.

Reviews problems associated with evaluating air pollution related health damage functions.

Mishan, E.J. "Evaluation of Life and Limb: A Theoretical Approach." Journal of Political Economy, 79:4 (July/August 1971) pp. 687-705.

Plessas, Demetrius J. The Social Costs of Air Pollution in the Greater Athens Region: Center of Planning and Economic Research, 1980. 174 p. Bibl.

Report of an attempt to measure the health effects of air pollution. Hospital admission data for respiratory and cardiovascular diseases are correlated with air pollution indices. The magnitude of social costs is estimated in terms of human productivity losses and the utilization of health services.

U.S. National Academy of Sciences, Institute of Medicine. Costs of Environment-Related Health Effects: A Plan for Continuing Study. Washington: National Academy Press, 1981. 193 p.

### II.D.3. Damage to Materials

Fink, F.W., et al. Technical-Economic Evaluation of Air Pollution Corrosion Costs on Metals in the U.S. Columbus, Ohio: Battelle Memorial Institute, 1971.

## II.E. Resource Use

The literature in this section provides a link between resource economics and environmental economics. The valuation, allocation, and management of water resources, minerals and natural environments is dealt with, and the relationship between resource use and environmental quality is established.

### II.E.1. Water (see also II.A.1. Agriculture)

Wollman, Nathaniel, and Gilbert W. Bonem. The Outlook for Water: Quality, Quantity and National Growth. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1971. 304 p.

Presents an economic model for assessing U.S. national water supplies. Estimates of water availability and demand by region to the year 2020 are calculated. The need for quality as well as quantity is assessed and projections of the need for, and cost of, treatment and storage are included. Policy issues which are discussed include the desirability of growth, the distribution of costs, and the assessment of aesthetic values.

### II.E.2. Minerals

Page, Talbot. Conservation and Economic Efficiency, an Approach to Materials Policy. Baltimore: Johns Hopkins University Press, for Resources for the future, 1977. 266 p.

A study of the economics of recycling. Reviews U.S. policies and practices.

### II.E.3. Wildlife and Wilderness Areas and Natural Environments

Hammack, Judd, and Gardner Mallard Brown, Jr. Waterfowl and Wetlands: Toward Bioeconomic Analysis. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1974. 108 p.

The methodology which is developed here could be of use in deciding how to allocate scarce resources to incompatible alternative uses. A model which combines economic and physical relationships is used to determine the optimal number of ponds, breeders, and seasonal kills.

Krutilla, John V. ed. Natural Environments: Studies in Theoretical and Applied Analysis. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1972. 362 p.

This volume includes papers by several scholars on the economics and management of natural environments. Among the issues which are addressed are: the problem of alternative uses, determination of the optimal capacity of recreation facilities, and classification of inland waters and landscapes.

Krutilla, John V., and Anthony C. Fisher. The Economics of Natural Environments. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1975. 292 p.

The research reported here deals with the management, valuation, and allocation of natural environments. Problems which are addressed include the overlapping of private and common property, assignment of liability for damages, and decisions on incompatible uses and irreversible actions. Application of the analysis is demonstrated in case studies of the valuation, allocation and management of public lands in the U.S.

United Nations Development Program, and Food and Agricultural Organization. Wildlife Management in Kenya, Project Findings and Recommendations. Rome: UNDP/FAO, 1980. 159 p. Bibl.

A plan for the management of wildlife resources which weighs the benefits of the tourism industry against the opportunity cost of other forms of land use and income distribution effects.

### III. Policy Issues and Mechanisms

Because environmental services do not pass through markets and are frequently used inefficiently, some form of public regulation may be necessary. In this section, works which deal with the effectiveness and macro-economic impacts of environmental control policies are enumerated.

#### III.A. General Works on Environmental Policy

The materials in this section provide an overview of policy issues. The relationship between theory and policy is explored.

Baumol, William, and Wallace E. Oates. The Theory of Environmental Policy: Externalities, Public Outlays and the Quality of Life. Englewood Cliffs, New Jersey: Prentice-Hall, 1975. 272 p.

Provides an overview of theory and policy tools. Includes chapters on distributional issues and international environmental issues.

Freeman, A. Myrick, III, Robert H. Haveman, and Allen V. Kneese. The Economics of Environmental Policy. New York: John Wiley and Sons, 1973. 184 p.

Presents the basic economics of environmental quality management. Reviews U.S. programs and makes suggestions for improvement.

Lindgren, Karl and Inger Olsson. The Macroeconomics of Environmental Protection. Stockholm: The National Swedish Environment Board, 1978. 189 p.

Outlines the costs of environmental damage as well as the costs of protection. Discusses the choice of control instruments and the distribution of the costs of control. Includes an overview of international policy issues and a synopsis of the policies of Sweden and several other industrialized countries.

#### III.B. Macroeconomic Impacts of Environmental Protection

The following works deal with the impacts of protection policies on a variety of macroeconomic indicators such as prices, GNP, employment and the balance of payments.

Fazio, A.G., and M. Lo Cascio. "Evaluation of the Economic Effects of Anti-Pollution Public Policy: Proposals for an Econometric Analysis Model." In Problems of Environmental Economics. Paris: OECD, 1972.

The authors estimate the percentage increases in costs and prices which resulted from antipollution measures taken by major Italian industries.

Organization for Economic Cooperation and Development. Economic Implications of Pollution Control, A General Assessment. OECD Studies in Resource Allocation, No. 1. Paris: OECD, 1974. 78p.

Reviews macroeconomic effects of pollution control programs in Germany, Italy, Japan, the Netherlands, Sweden, the U.K, and the U.S. Topics which are covered include GNP, unemployment, prices, the relative supply of public and private goods, the balance of payments, and regional and sectoral consequences.

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Employment and Environment. Paris: OECD, 1978. 68p.

Includes background papers for, and conclusions reached by, a meeting of experts. In a report by the Secretariat, possible employment effects are outlined; actual data for several OECD countries are reviewed; and some specific problems such as plant closures are discussed. A paper by Robert Haveman outlines basic principles to be followed in analyzing the issue. Haveman also suggests a policy position.

Resources for the Future Environmental Policy Evaluation Team. Environmental Gains and Economic Losses: A Connection. A Report for the Environmental Assessment Council of the Academy of Natural Sciences. Washington: Resources for the Future, 1980. 214 p.

A study of the impacts of environmental regulation on productivity, inflation, and employment. Benefits as well as costs are covered. Policy options and new approaches are discussed.

### III.C. Subsidies, Charges, and Standards

The effectiveness and efficiency of a variety of environmental control mechanisms are analyzed in the works listed below.

Anderson, Frederick R., Allen V. Kneese, Philip D. Reed, Serge Taylor and Russel B. Stevenson. Environmental Improvement Through Economic Incentives. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1977. 195 p.

The advantages and disadvantages of using pollution charges to control a variety of environmental problems are examined.

Gabowski, Henry G., and John M. Vernon. The Impact of regulation on Industrial Innovation. U.S. National Academy of Sciences, 1979. 64p.

This monograph is the product of a workshop during which a panel of experts generated suggestions on how regulations could be modified to reduce the negative effects on innovation without eliminating the benefits. Of interest is the section on social, i.e. health, safety, and environmental, regulations.

Organization for Economic Cooperation and Development. The Polluter Pays Principle. Paris: OECD, 1975. 117 p.

Part I of this volume contains three official OECD texts in which the polluter pays principle is defined and its implementation is recommended. Part II includes five studies in which principles and methods of implementation are explored and problems of implementation are discussed. Among the instruments which are examined are: direct controls, taxes, charges, subsidies, incentives such as tax benefits, and the auction of pollution rights.

Russell, Clifford S. "What Can We Get from Effluent Charges?" Policy Analysis, 5:2, (Spring 1979) pp. 155-180. (REF reprint 166)

Four charge schemes are identified and are compared with regulatory alternatives in terms of their economic efficiency, information requirements, susceptibility to political pressure, and problems of enforcement.

### III. D. Distributional Effects

Environmental damages do not affect all socio-economic groups in the same way. Likewise, the costs and benefits of environmental protection have differential impacts. In the following studies, some of these distributional effects are identified and techniques for analyzing them are proposed.

Baumol, William J. "Environmental Protection and Income Distribution." In Harold M. Hochman and George Peterson, eds. Redistribution Through Public Choice. New York: Columbia University Press, 1974. pp. 93-111.

An analysis of the incidence of unemployment resulting from environmental protection.

Freeman. A. Myrick, III. "The Distribution of Environmental Quality."  
In Allen V. Kneese and Blair T. Bower, eds. Environmental Quality  
Analysis: Theory and Method in the Social Sciences. Baltimore:  
Johns Hopkins University Press, for Resources for the Future, 1972.  
pp. 243-278.

The author sketches an analytical framework for investigating  
distributional effects and then examines some existing data. The  
ways in which equity concerns might affect decisions about environ-  
mental quality management are discussed.

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\_\_\_\_\_ . "The Incidence of the Costs of Controlling  
Automotive Air Pollution." In F. Thomas Juster, ed. The Distribution  
of Economic Well-Being. Cambridge, Mass.: Ballinger, 1977. pp. 163-193.

Using a model of new and used car demand, prices and user costs, and  
data on automobile purchases and ownership by income group, the author  
analyzes the distribution of automotive pollution control costs  
associated with the U.S. Clean Air Act of 1970. The same analysis is  
applied to alternatives to the Clean Air Act. The effectiveness of  
subsidies in alleviating the regressive impact of such controls is  
also assessed.

Gianessi, Leonard P., Henry M. Peskin, and Edward Wolff. "The Distributional  
Implications of National Air Pollution Damage Estimates." In F. Thomas  
Juster, ed. The Distribution of Economic Well-Being. Cambridge, Mass.:  
Ballinger, 1977. pp. 201-227. (RFF Reprint 150).

The author reports the development of a technique for measuring distri-  
butional impacts. Population statistics and estimates of pollution damage  
from all sources are used to calculate per capita damages for different  
income and racial groups.

Zupan, Jeffrey M. The Distribution of Air Quality in the New York  
Region. Resources for the Future Paper, 1972. 102p.

Using data on air quality, information on the location of emission  
sources, and income data derived from income tax returns, the author  
demonstrates a correlation between air quality and income levels.



### III.E. International Institutions and Policies

The materials in this section deal with two subjects: the international economic implications of environmental protection policies and the establishment of international policies and institutions.

d'Arge, Ralph C. and Allen V. Kneese. "State Liability for International Environmental Degradation: An Economic Perspective." Natural Resources Journal, 20 (July 1980), pp. 427-450. (RFF reprint 182)

Discusses the economic implications and efficiency of four alternative principles for allocating responsibility for the abatement of transfrontier pollution.

Koo, Anthony Y.C., with Maureen Kallick, James Morgan and Soo-Yong Kim. Environmental Repercussions on Trade and Investment. A study prepared for the International Labor Office. Michigan State University, International Business and Economic Studies, 1979. 183 p.

McLeod, Scott. Financing Environmental Measures in Developing Countries: The Principle of Additionality. IUCN Environmental Policy and Law Paper No. 6. Morges, Switzerland: International Union for Conservation of Nature and Natural Resources, 1974. 54 p.

The term additionality refers to funding for environmental protection over and above the existing level of funds available for development aid. In this paper, the term is defined and clarified and its applicability is discussed. Problems of measuring and allocating costs and benefits and the issue of responsibility for damages are also covered. Sources of funding for the additional costs of environmental protection are explored.

Organization for Economic Cooperation and Development. Economics of Transfrontier Pollution. Paris: OECD, 1976. 218 p.

A collection of papers covering general economic principles as well as instruments and institutions for resolving transfrontier problems.

Steinberg, E.B., J.A. Yager, and G.M. Brannon. New Means of Financing International Needs. Washington: The Brookings Institution, 1978. 250 p.

This is not, strictly speaking, a book about environmental economics. It is of interest because it deals with proposals for taxes on pollution of the international marine commons. Administrative as well as economic implications are analyzed.

#### IV. Growth and the Limits to Growth

Consideration of the magnitude of environmental damages resulting from man's activities and of the assimilative capacity of the earth has led many environmentalists to conclude that the pursuit of economic growth, as measured by conventional growth indices, is a foolhardy and eventually impossible endeavor. Other analysts have considered past and present economic experience and technological progress and have concluded that continued growth is both desirable and feasible and can be reconciled with environmental protection. The literature presented in this section provides analyses on both sides of the argument.

Barnett, Harold, and Chandler Morse. Scarcity and Growth. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1963. 288 p.

Historical data on the cost per unit of resources in the U.S. is examined in order to test the validity of the doctrines of increasing resource scarcity and diminishing returns under conditions of economic growth. The authors conclude that technological advances and the creation of substitutes for scarce resources allow modern societies to avoid resource constraints.

Beckerman, Wilfred. In Defense of Economic Growth. London: Jonathan Cape, 1974. 287 p.

Beckerman points out defects in the limits-to-growth analysis and maintains that technology and economics provide the means of controlling the growth of "bads."

Boulding, Kenneth. "The Economics of the Coming Spaceship Earth." In Henry Jarrett, ed. Environmental Quality in a Growing Economy. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1966. pp. 3-14.

Boulding describes the relationship between the economic system and the environment. He points out that welfare is derived not only from consumption but also from the quality of the environment.

Brown, Lester R. Building a Sustainable Society. New York: W. W. Norton, 1981. 433 p.

Part I is a review of the various forms of stress which are currently affecting the earth's environmental systems. In Part II, Brown outlines the changes in our social and economic systems which he believes are necessary to avert disaster and create a sustainable society.

Converse, Alvin O. "Environmental Controls and Economic Growth."  
Journal of Economic Theory, 7:4 (April 1974) pp. 411-417.

The author uses a modified form of the Solow growth model to determine the level at which environmental controls would cause economic growth to cease.

Daly, Herman E. Steady State Economics: the Economics of Biophysical Equilibrium and Moral Growth. San Francisco: W.H. Freeman and Co., 1977. 185 p. Bibl.

Part I is a proposal for holding population and the stock of physical wealth at some desired and sufficient levels which can be achieved by low rates of depreciation and depletion. The second law of thermodynamics in the basis of Daly's argument that unlimited growth is physically impossible and eventually exacts more costs on the ecosystem than it produces in benefits. Daly develops an expanded economic framework which encompasses flows of resources and wastes. The concept of efficiency is discussed in detail. Part II is a critique of growth arguments.

Mishan, E.J. The Costs of Economic Growth. New York: Praeger, 1967. 190 p.

An essay in which it is argued that conventional economic practice and the emphasis it places on growth indices are more likely to result in a decrease rather than an increase in social welfare for Western societies. Among the costs of growth which Mishan analyzes are environmental damages and occupational illnesses and accidents. He also discusses income distribution, technological unemployment, and other social costs of growth which are not included in conventional economic analysis.

\_\_\_\_\_. "Growth and Anti-Growth: What are the Issues?"  
Challenge, 16:2 (May/June, 1973). pp. 26-41.

\_\_\_\_\_. Technology and Growth, the Price We Pay. New York: Praeger, 1970. 193 p.

A popular version of The Costs of Economic Growth. Some of the more technical material has been deleted or abridged in order to make the work more accessible to the educated layman.

Ridker, Ronald G. "Resource and Environmental Consequences of Population and Economic Growth." In Philip M. Hausen, ed. World Population and Development: Challenges and Prospects. Syracuse, New York: Syracuse University Press, 1979. pp. 99-123. (RFF reprint 172)

Presents projections for five countries: the U.S., India, Indonesia, Columbia, and the Philippines as well as global projections for a fifty year period.

Ridker, Ronald G., and William D. Watson. To Choose a Future: Resource and Environmental consequences of Alternative Growth Paths. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1980. 478 p.

The authors have developed a methodology for projecting resource scarcity and environmental pressures resulting from population growth, economic growth, and other major developments. In an attempt to refute the limits-to-growth theory as it applies to the U.S., several scenarios are presented and the consequences of each are analyzed.

Schumacher, E. F. Small is Beautiful, Economics as if People Mattered. New York: Harper and Row, 1973. 305 p.

A collection of essays in which the author criticizes the reliance of conventional economics on quantitative techniques. He argues for the need to make qualitative as well as quantitative judgements about resources, products and services, and their contribution to consumers' well-being. Schumacher espouses an economic vision which treats the earth's resources as working capital and which operates to minimize the negative effects of large-scale production technologies, waste production and resource depletion.

Simon, Julian Lincoln. The Ultimate Resource. Princeton, N.J.: Princeton Univ. Press, 1981. 415 p. Bibl.

The author argues that, in the long run, the resources and the waste absorption capacity of the earth are not finite and that the potential for increasing the service yielded per unit of resource is unlimited. Simon explores in detail the relationship between population growth and standards of living in both the developed and developing countries, and concludes that population control is not necessarily justified.

Smith, V. Kerry, ed. Scarcity and Growth Reconsidered. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1979. 297 p.

The research reported here was conceived as a reevaluation of the issue of natural resource scarcity which was addressed in the earlier book by Harold Barnett and Chandler Morse (listed above). The current volume includes contributions by twelve recognized experts on the subject. A great diversity of professional opinions is represented. Smith and Krutilla challenge the classical view, based on the concept of natural prices, which was adopted by Barnett and Morse. Barnett presents an updating of his previous work and maintains his optimism about the feasibility of continued growth.

Smith, V. Kerry, and John V. Krutilla. "Resource and Environmental Constraints to Growth." American Journal of Agricultural Economics, LX1:3 (August 1979) pp. 395-408.

The authors challenge previous analyses of resource scarcity which ignore the use of common property resources. It is argued that these resources should be analyzed as though they were depletable or subject to the limits of renewability.

Schurr, Sam H., ed. Energy, Economic Growth and the Environment. Papers presented at a forum conducted by Resources for the Future in Washington, D.C. Baltimore: Johns Hopkins University Press, for Resources for the Future, 1972. 240 p.

A collection of eight papers by authors with widely divergent views on the complex relationship between the use of energy, economic growth, and the quality of the environment.



ENVIRONMENTAL SECURITY AND GLOBAL DEVELOPMENT

-The Essential Connection-

Forty-sixth Annual Meeting of the  
National Wildlife Federation

by

Dr. James A. Lee

The World Bank

Milwaukee, Wisconsin  
March 20, 1982

ENVIRONMENTAL SECURITY

AND

GLOBAL DEVELOPMENT

-The Essential Connection-

Dr. James A. Lee

I am very pleased to have been invited to participate in your deliberations this morning -- and, I am indebted to Jay Hair and Gomer Jones for their many kindnesses in making it possible.

I feel very much at home in this assembly -- for many reasons, not the least of which is that much of my early academic training and professional work was closely related to wildlife. In the audience are several of my vintage who knew and worked with me in those days. And, I look back upon those experiences with both nostalgia and a real sense of gratitude for we were privileged to know and associate with some of the giants in the natural sciences, conservation and wildlife management. It was an exciting and challenging part of my life -- being a game warden, biologist, researcher, administrator and teacher, and in more than one state.

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Prepared for delivery at the Forty-sixth Annual Meeting of the National Wildlife Federation, March 20, 1982, Milwaukee, Wisconsin.

The views expressed in this paper are solely those of the author and do not necessarily reflect the policies or practices of the World Bank.



Wildlife continues to be an important dimension in both my personal and professional life. I am fortunate now that my work takes me to all corners of the world where I can view and marvel at the diversity of wildlife from the High Arctic to the Australian outback, from the tropical forests of Amazonia to the savannahs of East Africa, from the Peruvian Andes to the deserts of the Sahel. Those of you who include wildlife within your orbit of interests and who work in its behalf have markedly enriched your lives. The stewardship which you have exercised over the wildlife resources of this nation and even those of others has been instrumental in their continued survival. The threats to wildlife which initially occupied your full attention in the early years of the Federation have now, however, given way to broader concerns for the future of mankind and its global home.

The concerns that have caused each of you to come together here are of immense moment -- make no mistake about it. Recent world events, political and economic, do, however, threaten to overshadow them in near-term importance. While daily our senses are numbed and our minds satiated by the expediencies and crises of the moment -- it is the fate and future of the global environment which warrants our continuing studied attention and longer-view appraisal.

What I wish to focus on over the next few minutes is the joint necessity for continued world-wide economic growth and development, and its maintenance through respect for the

integrity of vital, life-supporting environmental systems. It is, after all, the environment which makes all development possible, which makes all life possible. The dilemma we face is how such a complex relationship between mankind and its culturally derived need to develop, and the environment and its not unlimited capacity for resiliency, can be made sustainable.

This is a time of growing uncertainty and doubts in the world's understanding of itself and its future. Some speak of the faded promise, while others preach of unlimited potential. Some see the "blood-dimmed tide of anarchy," while others see the dawn of a glorious age now possible through technology of revolutionary proportions. Be it fear or hope that stirs within you, be certain that profound movements are at work globally -- in politics and in the economy -- movements that are vast and sweeping in their scope and, perhaps, irreversible in their consequences.

The world economy is undergoing dramatic revisions. The old order changeth and in the process an inescapable fact is emerging. And, that is, the world's economy is now truly global and can be characterized in a word -- namely, interdependence.

The fact of interdependence is ahead of its perception by governments and the public alike. Policymakers seeking to reflect national self-interests are experiencing difficulties. They are discovering that their vested interests are inextricably linked to the vested interests of others around the world. An

American corporate leader recently viewed the discovery this way:

"When we talk about the future of America, we have to remember that it is inextricably tied to the future of the rest of the world. That, unfortunately," he said, "is not a particularly reassuring thought."

The engine that drives the world economy is development, and development rests upon the underpinnings of the environment. If the environmental underpinnings of the world's economic system cannot be secured, if they cannot give evidence of being able to sustain present and future development, then economic dislocations and outright breakdowns would seem to be in our future.

A colleague of mine after carefully studying the emerging scene describes it this way, " .... the picture emerging is one of the advent of an age of global scarcity in a world of increasing populations. There are varying views on the degree of tension inherent in this situation, on the ways this tension is likely to manifest itself, and how it can be alleviated -- but there is no disagreement on how somber are the prospects."

The Global 2000 study, with which you are all familiar, concludes that every projection in the study points to increased pressures on the global environment. This study makes it abundantly clear that no longer can a nation plan the future of its population, its resources, its economy and its environment independent of what is taking place in the rest of the world. The Global 2000 study reinforces what other studies of the world

economy are also revealing and, that is, the most important problems facing nations today, the problems of political stability, economic growth, social equity and international security are becoming part of a highly interconnected macro-problem. Pivotal to this is the issue of sustainable development.

A world that now has over four billion inhabitants; a world divided to an alarming and increasing degree by a poverty curtain that is giving rise to social tensions threatening of international security; a world in which soon over seventy-five percent of the then six billion inhabitants will intensify pressures on an already stressed environment and swell the ranks of the poverty-stricken; a world evidencing continued environmental degradation -- deforestation, topsoil loss, desert encroachment, water scarcities, overgrazing, overfishing, toxic wastes and pollution -- in such a world the only kind of development that can make any sense is development that is capable of meeting minimal human needs and of being sustained.

There are no quick fixes to the problems posed by the conflicting triad of population, resources, and the environment. In a word, the world needs a new ethic of development, one that rests squarely on a recognition of the irreplaceable role of the environment in supporting the world's burgeoning population. The demonstrable evidences of environmental degradation lead us to render remedial treatment to the symptoms (and even that is

grossly inadequate). What is required is for us to deal more directly with the causes and that will entail a willingness to consider new development strategies. Such strategies would be minimally disruptive to life-supporting environmental systems, and maximally dependent on renewable resources, their conservation and prudent management.

Present trends and thinking would seem to suggest, however, that we are not seriously considering such a transition. Recently, when reviewing the economic and environmental trends over the decade that has elapsed since the 1972 Stockholm Conference on the Human Environment, I pondered the reasons behind the unsettling findings of the Global 2000 and related studies. There is still abroad in the world a universal complacency about the state of the environment. Somehow the prospects are not taken seriously -- either they have not been widely communicated, or well understood, or they are not believable enough, not immediate enough or, it is somehow taken for granted that if and when conditions become that intolerable appropriate corrective actions will be taken, and in time. If this be the thinking that prevails, it will prove extremely difficult to construct an economic order centered around sustainable development.

How can we focus human attention on the longer-term issues of global survival and the adjustments inherent in such a consideration? Who will be entrusted with the global planning

when the lead time for correct diagnosis and analysis leading to corrective action far exceeds the time horizons of political leaders and the general public? A case in point is the problem surrounding the buildup of carbon dioxide in the atmosphere. There is mounting evidence that increased CO<sub>2</sub> concentrations will create alterations in the global climatic patterns with significant consequences for agriculture. Even among the best informed, however, there are differences expressed on the nature, dimensions, and timing of the consequences. Estimates suggest that disruptive changes could occur by 2050, certainly within the lifetime of today's young people. Yet it is the uncertainty and timing of the consequences that prevents or delays corrective action being taken now. In point of fact, however, it is the capital investment decisions and national energy policies being formulated over the next ten years that will ensure that very buildup of CO<sub>2</sub> to concentrations thought to trigger climatic changes.

It is interesting to note that the world's family of nations are bearing the heavy costs of arming themselves against perceived threats to their national security. Some six to seven hundred billions of dollars are being spent annually ostensibly to deter aggression and threats to international peace. At the same time no less a threat to both national and international security continues largely unrecognized and unabated. I am referring to the demise of the world's environmental systems

which, because it proceeds insidiously and incrementally, and the consequences are further removed in time, is accorded relatively scant attention.

Admittedly, the emergence of environmental insecurity as a global threat is something of a new phenomenon. Just as the interdependencies and linkages that now characterize the evolving world economy are becoming apparent, so, too, the interrelatedness of our resource underpinnings and their essential role in sustaining development are just becoming apparent to a wider audience.

And so, I would make several points this morning that I believe warrant your individual attention and the attention of the Federation as it approaches a half-century of service in defense of the environment.

- first, the security of nations, and therefore, of the world depends ultimately on achieving sustainable development; hence, our perspective must be global;
- second, development must allow for economic growth on the part of both developed and developing nations if it is, in fact, to be sustained;
- third, sustainable development requires that national development strategies include vigorous attention to the environment, resources management, and social equity.

Environmentalism such as characterizes the Federation need not be solely identified with precautions in development, and with protective and corrective measures -- as important as they are now and increasingly will be in the future. I believe, however, that some of the most effective environmental efforts will be those that achieve development and economic growth while at the same time ensuring its sustainability.

The question, it seems to me, is not whether there should be continued economic growth. There must be. Nor is the question whether the integrity of the environment must be respected. It has to be. Nor -- least of all -- is it a question of whether these two considerations are interlocked. They are. The solution to the dilemma revolves clearly not about whether -- but about how. How development can proceed in ways minimally disruptive to the environment and in ways maximally promising of a more equitable distribution of the fruits of such development -- individual self-fulfillment, social harmony and international stability.

How then can we reconcile the global imperative to assist in the economic advance of all peoples, with our responsibility to safeguard the environment -- the environment which makes all development possible?

To my mind, five essential requirements stand out:

- . Recognize that economic growth in all countries is essential if, for no other reason, we are to avert economic, political and social disaster.



- . Act on the evidence that such growth, if properly planned and executed, need not cause unacceptable environmental penalties.
- . Assist nations in the choice of patterns of growth which, above all, promise to be sustainable, yield reasonable economic gains with minimal environmental risk.
- . Provide the world's poorer nations with urgently needed concessionary aid to promote the kind of development that will prevent ecological disaster, and the middle-income countries with greater access to commercial capital conditioned for environmentally sound development.
- . Finally, to understand that human degradation that grows out of persistent and pervasive poverty now threatening hundreds upon hundreds of millions of people is the most dangerous threat to the environment.

From my travels throughout the world, I am convinced that the one pollutant, if you will, that threatens above all others to destroy the environment, to destroy the very essence and spirit of mankind, to destroy within man that unique quality of humaneness which even now is being severely tested, is the permanent condition of poverty.

Advancing social equity, economic growth, and environmental protection -- the necessary ingredients for international security -- requires the forging of new relationships between entities that collectively can make it or not make it happen. And, more often than not, these entities have, heretofore, exhibited hostility, and adversary relationships have prevailed. Perhaps it's worth remembering that in man's evolutionary history culture made its initial appearance when early man discovered the value of cooperation in supplanting confrontation to achieve his goals. It is no less true today.

I believe Jay Hair has referred to this as "detente" -- that is, creating an atmosphere where the dialogue about environment and development can proceed along lines that acknowledge the twin necessities of economic development and the protection of the environment to ensure sustainability. I would suggest we move toward an "entente cordiale," a friendly agreement if you will, where both the development and environmental communities seek how best to proceed towards achieving a sustainable society.

In conclusion, I would say to you here this morning, you who long ago mounted the ramparts in defense of the environment -- reach out to those who would transform and develop the environment in behalf of the human condition, and seek not always to stop but rather how better to proceed.

And, I would say to those who, in many places, have the responsibility for planning, or financing, or executing, or profiting from development -- pay attention to what the environmental barometer is telling you for the forecast is ominous. Acknowledge that the man-environment apartheid can no longer be tolerated.

The international development community and the international environment community have a common stake in building a sustainable society. When both come to the realization that it is globally imperative to move in lockstep, then we will have taken a first big step forward befitting the rationality that, hopefully, still characterizes mankind.

Related Reading

United States Council on Environmental Quality, The Global 2000 Report and Global Future: Time to Act. Reports to the President on Global Resources, Environment and Population (Washington, D.C. 1980 and 1981).

The World Bank, World Development Reports, 1978-1982 (Washington, D.C., World Bank).

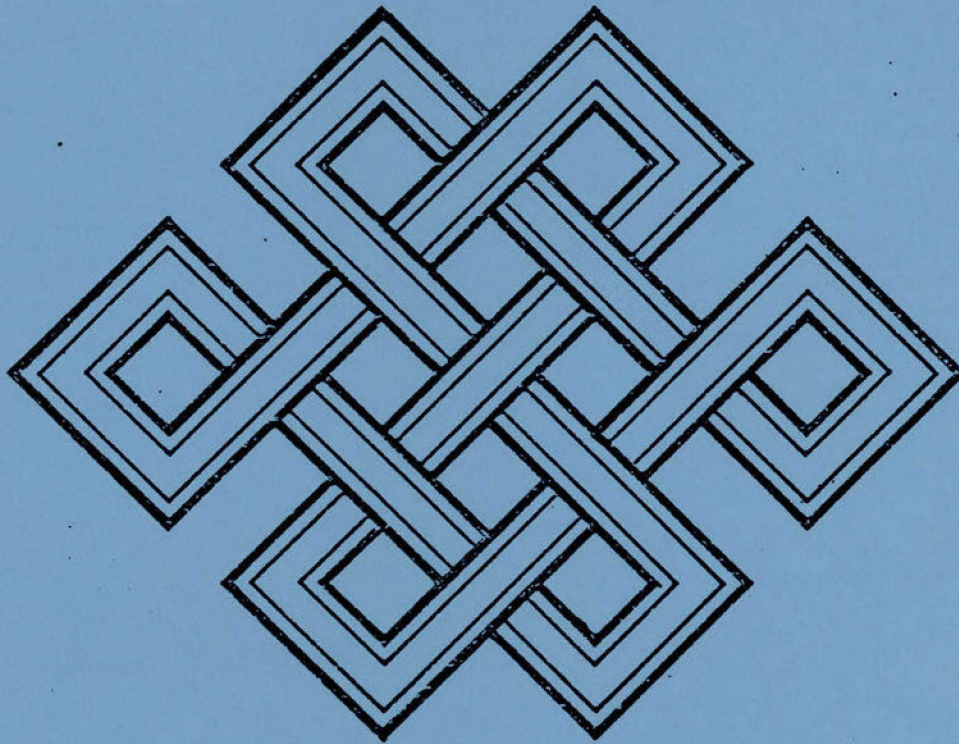
Independent Commission on International Development Issues (The Brandt Commission) North-South Dialogue: A Program for Survival (Cambridge, Mass. MIT Press, 1980).

Organization for Economic Cooperation and Development, Interfutures: Facing the Future (Paris, OECD, 1979).

Overseas Development Council, The United States and World Development: Agenda 1980 (New York, Praeger, 1980).

United Nations Environment Programme, The State of the Global Environment: A Decade After Stockholm (Nairobi, Kenya, to be published in 1982).

Lester R. Brown, Building a Sustainable Society (New York, W.W. Norton & Co., 1981).



AN ANNOTATED BIBLIOGRAPHY ON SUSTAINABLE DEVELOPMENT -

A Selective Reference Guide

Office of Environmental Affairs  
The World Bank  
1983

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## INTRODUCTION

In the Fairfield Osborn Memorial Lecture delivered by the World Bank's President, A. W. Clausen, in Washington, D.C., on November 12, 1981, Mr. Clausen spoke about "Sustainable Development: The Global Imperative". In addressing the conditions for economic growth that will achieve lasting improvements in people's lives, he emphasized the close interdependence of economic development and the environment. He discussed the following points:

- "- first, that if our goal is sustainable development, our perspective must be global;
- second, that human development must allow for continued economic growth, especially in the Third World, if it is to be sustainable; and
- third, that sustainable development requires vigorous attention to resource management and the environment".

In the context of his last point, Mr. Clausen referred to the numerous efforts already undertaken by the various sectors within the Bank to promote economic development that links socio-economic improvements with the protection and conservation of natural resources. "For sustainable development, and wise conservation," he concluded, "are, in the end, mutually reinforcing -- and absolutely inseparable -- goals."

This bibliography concerns sustainable development. Since the limits-to-growth debate initiated by the Club of Rome in 1972, environmentalism, in general associated with purely protective measures, has grown into a more active interest and involvement in development processes themselves. Aside from promoting the preservation of natural and environmental resources as such, environmental conservation now encompasses their wise use and management at levels and in ways that ensure continued productivity. A primary concern is to explore and consolidate patterns of human and economic development that can be supported over the long run by physical and biophysical environments.

In the recent past the signs indicating that we are at the end of an era of indiscriminate economic growth have multiplied and have led to a questioning of current economic theory and practice:

- The problems inherent in the economic system itself are increasing. Most national economies face rising inflation and unemployment. Economic progress has become dependent on a high rate of technological innovation.
- Economic growth in itself has not been able to solve the world's greatest problems: hunger and poverty.



- The energy crisis was a demonstration of the extent to which the functioning of modern economies depends on cheap and abundant energy supplies. Energy-intensive production modes and distribution networks can make national economies vulnerable to sudden changes in global political and economic conditions.
- The natural environment proves not to be eternally resilient against its use and abuse by mankind. Its carrying capacity is limited. Its resources are exhaustible.

A body of criticism has evolved addressing the underlying goals and values of economic development and focusing on the narrow definitions of economic efficiency and productivity that fail to take into account social and environmental dimensions. The criteria of conventional economics alone are considered inadequate to guide future development because they ignore a timeframe beyond the conventional economic cycle. What in economic theory is termed "externalities" is moved to the core of the discussion on sustainable development. The real cost of economic growth, the way its benefits are distributed, and its potential to secure a basis for living for the generations still to come are the touchstones of "alternative economics." (See also OEA document entitled "An Annotated Bibliography of Environmental Economics," 1981)

The bibliography in hand is intended to serve as a reference guide to World Bank staff and other parties interested in the theory and practice of sustainable development. A single bibliography dealing with such a broad issue can lay no claim to comprehensiveness and must necessarily be incomplete. Also, since there is no widely accepted consensus on what makes development sustainable, any selection of literature, this one included, will be biased. The objective of this bibliography will be, therefore, rather

- to identify and annotate good literature that highlights the major issues involved and to provide a starting-point for further exploration;
- to give an overall perspective of a sustainable future by gathering the many strands of the discussion on, and of the search for, alternative ways of development.

The scope of the literature cited (180 entries in total) ranges from an overall discussion of concepts and strategies to examples of their application and practical knowhow. Accordingly, the bibliography is organized into two parts, a more general one (Part One) and a more specific one pertinent to the sectors to which the World Bank lends (Part Two).

Part One includes literature that:

- in response to the present economic and environmental problems suggests new directions and fundamental changes in economic and social structures;
- analyzes the roots of the crisis and interprets it as a challenge to revise habitual ways of life and ways of thinking;
- discusses the conditions necessary to harness economy and technology to human ends.

As present economic and environmental trends are interrelated and global in scale, Part One includes literature that addresses the broad issues as they relate to the industrialized and to the developing countries.

Part Two includes literature that:

- provides guidance for integrated development and sectoral development, with emphasis on environmental concerns;
- discusses the issues of sustainable development relevant to the different sectors and the contributions every sector can make to sustainable development;
- explores approaches to development that seem to be socially viable, ecologically sound, and economically feasible;
- gives sources of information for further investigation

As this bibliography is mainly intended for World Bank staff and people involved in Third World development, Part Two is compiled in view of the developing countries and cites only those publications addressing the industrialized countries that can be of interest to the developing countries, too.

Most of the listed publications have been selected from recent literature in the attempt to give an idea of important new approaches and a state-of-the-art of the discussion on sustainable development.

As Mr. Clausen pointed out in his Fairfield Osborn Memorial Lecture, The World Bank is concerned with promoting long-term development objectives. At this point in time, however, there is no multisectoral Bank document that articulates this concern and places the Bank's lending policies in this context, nor are project evaluation methods applied that reflect the Bank's interest in sustainable development practices (for example, a systematic upgrading or downgrading of a project's economic rate of return in proportion to its environmental implications). Also, no Bank-wide analysis exists of the totality of long-range impacts -- beneficial and detrimental -- of past Bank projects on communities and

their physical environments. It is our hope that this selection of literature might be an incentive and a basis for further discussions in this direction.

Finally, we wish to thank those people from inside and outside of the Bank who through their advice and willingness to share ideas have helped in the preparation of this bibliography.

Notes:

\* The abbreviation "Ref." at the end of an entry indicates that the publication is based on reference material or provides lists of further readings. These references are emphasized in the annotation, if they seem to be particularly useful for a more in-depth study of the topics in question.

\* References to periodicals and publication series are marked with (P), information sources with (I). Both are listed at the end of each section.

\* Page numbers are given without number of introductory pages.

February, 1983

PART ONE: THE CONCEPT OF SUSTAINABLE DEVELOPMENT -  
ITS IMPLICATIONS FOR SOCIETY AND THE INDIVIDUAL

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1. GENERAL LITERATURE

BROWN, Lester R.

Building a Sustainable Society

New York: W.W. Norton, 1981

433 p.

Ref.

Argues that the transition towards a sustainable society is inevitable due to the economic and environmental pressures, and that a major reorientation in population and economic policies is vital to arrest and reverse the trends that erode the global resource base.

Part I is a review of the present deterioration of the global environment.

Part II outlines the steps that in Brown's opinion are necessary for survival: the shift to renewable resources, the stabilization of the world's population, the protection of cropland, major reforestation of denuded areas, and the departure from wasteful production and consumption.

BROWN, Lester R. and SHAW, Pamela

Six Steps to a Sustainable Society (Worldwatch Paper 48)

Washington, D.C.: Worldwatch Institute, 1982

64 p.

Ref.

Paper distilling the principal policy recommendations from Building a Sustainable Society.

COOMER, James C. (ed.)

Quest for a Sustainable Society

New York: Pergamon Press, 1979

260 pp.

Ref.

Nine prize-winning papers from the 1979 Mitchell Prize Competition as part of the Woodlands Conference Series on Sustainable Societies, and three other outstanding entries from this competition. The essays deal with the qualitative aspects of growth and growth policy and discuss which implications the redirection of social values would have for political and economic life.

DALY, Herman E.

Steady-State Economics - The Economics of Biophysical Equilibrium and Moral Growth

San Francisco: W.H. Freeman & Co., 1977

186 pp.

Ref.

Advocates a "steady-state" or no-growth economy that would be characterized by a constant stock of people and artifacts and a minimum "throughput" necessary to maintain the balance. The notion of growth is interpreted as the development towards maturity or sufficiency. Argues on the basis of the Entropy Law. Also brings to the fore ethical principles, in particular the sense of stewardship of the earth and the extension of brotherhood to future generations and subhuman life.

DALY, Herman E. (ed.)  
Economics, Ecology, Ethics - Essays Towards a Steady-State Economy  
San Francisco: W.H. Freeman & Co., 1980  
372 pp. Ref.

Brings together twenty-two new and classic essays on the physical and ethical principles of the concept of a steady-state economy and updates material contained in the editor's previous book on the subject. Among the contributors are Kenneth Boulding, Paul and Anne Ehrlich, Nicholas Georgescu-Roegen, Garrett Hardin, and E.F. Schumacher.

HOLLANDER, Seth  
Annotated Bibliography on Population, Resources and Environment Relationships  
New York: National Audubon Society, 1982  
79 pp.  
Contact: Environmental Policy Analysis Department  
National Audubon Society  
950 Third Avenue, New York, N.Y. 10022

Bibliography focusing on publications covering resources and population from an environmental perspective. Publications are drawn from many subject areas including human ecology, land use, agriculture and food, demography, natural resources, and energy policy.

MEADOWS, Dennis (ed.)  
Alternatives to Growth I: A Search for Sustainable Futures  
Cambridge, Mass.: Ballinger Publ. Co., 1977  
405 pp. Ref.

Papers adapted from entries to the 1975 Mitchell Prize and presentations before the 1975 Woodlands Conference. Grouped under the topic areas nutrition and energy, economic alternatives, the politics of equity and social progress, and life styles and social norms.  
(Alternatives to Growth II - forthcoming)

NASH, Hugh (ed.)  
Progress as if Survival Mattered - A Handbook for a Conserver Society  
San Francisco: Friends of the Earth, 1977  
320 pp.

Collection of twenty essays on the major topics of alternative politics and economics: population, resources, energy, agriculture, health, education, decentralization, war and defense.

OLTMANS, Willem L. (ed.)

On Growth - The Crisis of Exploding Population and Resource Depletion  
New York: Putnam's Sons, 1974

494 pp.

On Growth Two - The World's Leading Thinkers on the Population Explosion and the Exhaustion of Resources

ibid, 1975

368 pp.

Interviews with seventy noted scientists and intellectuals (first volume) and with about fifty authorities from Third World socialist and Eastern countries (second volume) that reflect the limits-to-growth debate initiated by the Club of Rome in 1972.

PIRAGES, Dennis Clark (ed.)

The Sustainable Society

New York: Praeger Publ., 1977

344 p.

Ref.

Collection of essays on the economic, political, and social implications of the transition towards a sustainable society. Issues addressed include costs and benefits of energy alternatives, political and institutional changes, equitable wealth distribution, inter-generational justice, new justifications and definitions of property rights, and slowed growth from the perspective of the developing and the socialist countries.

- (P) SUSTAINABLE SOCIETIES - The Newsletter of the Woodlands Conference  
Contact: P.O. Box 9663, Arlington, Virginia 22209

Quarterly on current issues in sustainable development. Includes contact addresses and literature lists on a regular basis.

- (P) WORLDWATCH INSTITUTE PUBLICATIONS

Contact: 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036

"Worldwatch was established to alert policymakers and the general public of emerging global trends in the availability and management of resources - both human and natural. The research program is designed to fill the gap left by traditional analyses in providing the information needed by decision-makers in today's rapidly changing and interdependent world. Worldwatch analyzes issues in a global perspective and interdisciplinary framework."

(Worldwatch brochure)

2. ECONOMICS

APPLEGATH, John

Human Economy: A Bibliography

Vol. I - Books

Amherst, Mass.: The Human Economy Center, 1981

77 pp.

Bibliography (partly annotated) on recent literature on human values-oriented approaches to economic issues and on contemporary realities in the areas of resources and ecology.

DONALDSON, Peter

Economics of the Real World

London: Penguin/British Broadcasting Corporation, 1974

248 pp.

Ref.

Exposition of the main strands of criticisms of both economics and economic policies. Based on a critical look at economic policy in postwar Britain, the author discusses how the parameters of conventional economics prove to be inappropriate in assessing how people's real needs and concerns are met. Setting his analysis in an international framework, he asserts that the mechanisms that create basic economic injustice are the same at the international as at the national level.

(Broadcasted as a BBC TV series of the same title)

GIARINI, Orio, and LOUBERGE, Henri

The Diminishing Returns of Technology - An Essay on the Crisis in Economic Growth

New York: Pergamon Press, 1978

122 pp.

Ref.

Analysis of the historical links between technology and economic growth. The present decline of the over-all efficiency of technological innovation for economic progress is interpreted as an "internal limit to growth." The authors conclude that, in the future, the productivity of technology will have to be measured in terms of improved autonomy and survival capacity rather than speed of production, economies of scale, and further concentration.

HENDERSON, Hazel

Creating Alternative Futures - The End of Economics

New York: Berkeley Publishing Corp., 1978

404 pp.

Ref.

In her collected writings, the author describes current economic and social changes and extracts the patterns of an emerging "counter-

economy" and social reorganization. Analyzes the shortcomings of traditional economics and argues for a sustained-yield economy based on renewable resources and labor-intensive production. Advocates citizens' and consumers' organizations and more flexible, human-scaled institutions to replace conventional political power.

HIRSCH, Fred

Social Limits to Growth

Cambridge, Mass.: Harvard University Press, 1976

208 pp.

Ref.

Analyzes the structural characteristics of modern economic growth and its social foundations. The author interprets three major socioeconomic issues - the paradox of affluence, the distributional compulsion, and the reluctant collectivism - as interconnected products of this structure, and reaches the conclusion that the solutions to the problems now facing the economically advanced societies are to be found in the domain of social ethics.

HODSON, H.V.

The Diseconomics of Growth

London: Earth Island Ltd., 1972

239 pp.

Critique of the growth concept in economic theory. Diseconomics are defined as the study of the non-economic outfall - measurable and non-measurable - from the economic system. While acknowledging the poor countries' claims to economic development, the author shows how a zero-growth economy might work, without stagnation, in economically advanced countries. He relates his critique to the issues of environmental damage and repair, population growth, urban problems, and resource depletion.

LEONARD, H. Jeffrey, DAVIES III, J. Clarence, and BINDER, Gordon (ed.)

Business and Environment - Toward Common Ground

Washington: The Conservation Foundation, 1977

435 pp.

Ref.

Collection of fifty-five essays that seeks to work against the increasing polarization between businessmen and environmentalists. By clarifying the underlying assumptions of both groups and by exploring opportunities for resolving the antagonisms, this book aims at furthering a constructive discussion on the issues of economic activities and the environment.

SCHUMACHER, E.F.

Small is Beautiful - Economics As If People Mattered

London: Harper & Row, 1973

305 pp.

Ref.



Book that had a major impact on the current thinking in the development field. The author's critique of economic science addresses the underlying "meta-economic" assumptions regarding man and nature, and states that economic and technological development must embody the four qualities of smallness, simplicity, capital-saving, and non-violence.

THE WOODLANDS CONFERENCE ON SUSTAINABLE SOCIETIES

Future Roles for the Private Sector

In: Technological Forecasting & Social Change, Vol. 22, Number 2 (Special Issue), October 1982

118 pp.

Ref.

Issue devoted to a group of winning papers from the 1982 Mitchell Prize Competition as part of the Woodlands Conference Series. The eight essays focus on the key role that the private sector will hold in the construction of a sustainable society and explore innovative ways in which it can link its role as wealth-creator with social objectives. Topics include: the private sector in its socio-economic context and its ability to contribute to a sustainable economy, cooperation between the private sector and small farmers in the LDCs, electric utilities as the key to capitalizing the energy transition, New England as a model for a self-reliant, "mature" region.

3. SOCIAL ORGANIZATION AND POLITICAL STRUCTURES

BARNET, Richard J.

The Lean Years - Politics in the Age of Scarcity

New York: Simon and Schuster, 1980

349 pp.

Ref.

The author asserts that theoretically there are ample resources in the world to support the global population projected for the year 2000. He investigates the ways governments and multinational corporations manage and control the global resource systems and argues that resource scarcity is the product of political and economic conditions. Based on his analysis, he outlines the principles of the "politics of survival." Annotated bibliographical chapter.

FERKISS, Victor

The Future of Technological Civilization

New York: George Braziller, 1974

369 pp.

Ref.

Examines liberalism as the political philosophy of the Western world in respect to its attitudes towards technology and concludes that it is inadequate to provide guidance to contemporary technologically-based society. Outlines the principles of "necessary utopia" i.e., an ecological humanism that implies man's conscious relationship with nature and with other men.

HARMAN, Willis W.

An Incomplete Guide to the Future

Stanford, Ca.: Stanford Alumni Assoc., 1976

150 pp.

Ref.

Social and cultural critique suggesting that society is approaching one of the great transformations of human history. The author discusses how the dominant image of man underlies the ways in which institutions and education are shaped and policies made. He analyzes four basic dilemmas of industrial society involving economic growth, work roles, distribution and technological control and argues that their solution lies in a whole-system change to the "transindustrial society" based on a new image of man.

HEILBRONER, Robert L.

An Inquiry into the Human Prospect (including: Second Thoughts on 'The Human Prospect')

New York: W.W. Norton, & Co., 1975

180 pp.

Five essays on the capability for change of individuals and political systems, capitalist and socialist alike, in view of the present crisis. The author expresses his skepticism whether any society can bring about alterations of the necessary magnitude. The 'Second Thoughts' basically confirm this opinion but give voice to the hope that "gifted leadership" in a democratic society will be able to motivate disparate groups.

HENDERSON, Hazel

The Politics of the Solar Age: Alternatives to Economics

New York: Anchor Press/Doubleday, 1981

434 pp.

Ref.

Collection of the author's most recent essays illuminating her basic critique of conventional economics and her advocacy for the "politics of reconceptualization" that are already influencing every field of society. She discusses the aspects and options of the long-term structural changes in production and consumption patterns towards more human-scaled economics and politics, and explores the role that governments can assume in this process.

JOHNSON, Warren

Muddling Toward Frugality

San Francisco: Sierra Club Books, 1978

252 pp.

Ref.

Takes an ecological view of history and suggests that in the future resource scarcity will inevitably shape society in the industrialized countries. The changes will, however, not occur through planned social action, but through a simple "coping behavior" or "muddling along" on the individual or community level. Adaptation will therefore bring about a more frugal economy but also a culture in which each person has more control over his/her livelihood and the social and political circumstances in which he/she believes.

LAPPE, Frances Moore, and COLLINS, Joseph

Food First - Beyond the Myth of Scarcity

Boston: Houghton Mifflin Co., 1977

467 pp.

Ref.

The authors deny the existence of absolute scarcity and assert that every country has the capacity to feed itself. Backed by case studies and statistics from all over the world, they argue that hunger is not caused by insufficient production, poor climate, inappropriate technology, discriminatory trade practices, insufficient capital, or over-consumption in the U.S., but by the fact that the majority of people in every market economy are increasingly cut out from control over productive resources. The task of Americans, they write, consists in

building a movement that supports and promotes self-reliance and democratization of food production in their own country and abroad. Extensive reference list.

NEWLAND, Kathleen

The Sisterhood of Man - The Impact of Women's Changing Roles on Social and Economic Life Around the World (Worldwatch Institute Book)

New York: W.W. Norton & Co., 1979

242 pp.

Ref.

Argues from the premise that without women's full participation humanity's problems cannot be solved. In the framework of the subject areas of legal status, education, health, mass media, politics, work and family life, the author discusses the costs, social and economic, of sex discrimination and points out the potential of women to be "catalysts for social change."

OPHULS, William

Ecology and the Politics of Scarcity - Prologue to a Political Theory of the Steady State

San Francisco: W.H. Freeman & Co., 1977

304 pp.

Ref.

Critique of American political values and institutions, in particular of the "non-politics of Laissez-faire." The future, as Ophuls foresees, does not lie in reformist actions but in a fundamental change or shift to the "systems paradigm." Does not offer any practical solutions but outlines the political philosophy that would underlie the steady state. Annotated chapter bibliographies.

STOKES, Bruce

Helping Ourselves - Local Solutions to Global Problems (Worldwatch Institute Book)

New York: Norton & Co., 1981

160 pp.

Ref.

Argues that the solution to global problems lies at the local level. In examining the fields of energy, population, housing, food, health, and employment around the world, the author demonstrates that through local self-help people can start to change society "from the bottom up."

4. INTERNATIONAL COOPERATION

BRANDT, Willi (Chairman)

North-South: A Programme for Survival (Report of the Independent Commission on International Development Issues)

London: Pan Books, 1980

304 pp.

Report submitted to the UNO as the result of an independent investigation by a group of international statesmen and experts. The central idea of the report is that the massive promotion of economic development in the lesser developed countries of the South is in the best interest of the rich countries of the North. The group gives recommendations as to how international solidarity can be achieved and made effective. Major points include trade liberalization, large-scale capital transfer to the South, an international monetary and tax system, international energy agreements, and disarmament.

FRIEDRICH EBERT FOUNDATION

Towards One World? - International Responses to the Brandt Report

London: Temple Smith, 1981

382 pp.

Responses of world statesmen and well-known academics to the Brandt Report.

ECKHOLM, Erik P.

Down to Earth - Environment and Human Needs (a publication by the International Institute for Environment and Development)

New York: W.W. Norton & Co., 1982

238 pp.

Ref.

A report on the state of the global human and natural environment prepared in commemoration of the tenth anniversary of the Stockholm Conference on the Human Environment. In writing about the topics of oceanic affairs, pollution, global atmospherics, croplands and wastelands, deforestation, and biological diversity, the author provides up-to-date information on the world community successes and failures to respond to the environmental crisis as articulated by the Conference. He treats environmental problems as rooted in the political structures and technological trends of society and stresses the links between the fate of the world's poor and the fate of nature.

FOOD AND AGRICULTURE ORGANIZATION

Agriculture: Toward 2000

Rome: FAO, 1981

160 pp (and Annex)

Presents two scenarios for development strategies in global food production to meet a demand that is expected to double by the year 2000. Outlines the conditions and requirements of the scenarios, that both involve massive increase in off-farm inputs, modernization, and updating of international policy frameworks, and their respective effects on national self-sufficiency and international trade.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES (IUCN) (in collaboration with UNEP, World Wildlife Fund, FAO, UNESCO)  
World Conservation Strategy - Living Resource Conservation for Sustainable Development

Gland, Switzerland: IUCN, 1980  
72 pp.

Ref., 20 maps

Recognizes that development and conservation operate in the same global context and that their goals have to be identical if they are to be successful. The document comprises objectives and priority requirements for conservation and sustainable development and a broad policy framework for international, national, and regional action.

McNAMARA, Robert S.

The Year 2000 Committee: A New Initiative

In: "Focus," Vol. 4, Number 3, 1982 (WWF publication)

Article describing the program of "The Year 2000 Committee" that has recently been established as a project of the World Wildlife Fund. The Committee's major thrust will be the improvement of scientific and institutional "foresight capacity" and the "strategic management" necessary to understand and moderate the problems that threaten to disrupt the world's environmental, economic, and political systems.

TOLBA, Mostafa Kamal

Development Without Destruction - Evolving Environmental Perceptions

Dublin: Tycooly International Publishing Ltd., 1982  
197 pp.

Selection of twenty-eight of the author's speeches given during the period 1974 to 1981 in his capacity as the Executive Director of UNEP. Provides an overview of the issues debated at recent international conferences on subject areas with important environmental dimensions, i.e., population, food, human settlements, desertification, renewable energy and others.

UNITED NATIONS ENVIRONMENT PROGRAMME

Choosing the Options - Alternative Lifestyles and Development Patterns

Nairobi, Kenya: UNEP, 1980

76 p.

Publication based on a series of seminars that were organized in preparation of the New International Development Strategy by the UNEP and the Regional Economic Commissions of the UNO in 1979 and 1980. Contains the summarized policy recommendations for each region, giving an overview of the issues of, and suggestions for, alternative modes of development on which consensus has been reached.

5. SCIENCE AND TECHNOLOGY

\* Eco-Science: Theory and Application

BROWN, M.T., and ODUM, H.T. (ed.)  
Research Needs for a Basic Science of the System of Humanity and Nature and Appropriate Technology for the Future (Results of a Workshop at Gainesville, Florida, May 1981)  
National Science Foundation and Florida Water Resources Research Center, University of Florida, 1981  
166 pp. Ref.

Consensus recommendations of the workshop formulate the need for research to develop a scientific and methodological framework for environmental design and engineering. The workshop papers give a state-of-the art overview on the issues of changing availability of resources in the landscape and the consequent changes in patterns of urban and regional growth (with focus on energy, water, and wetlands). Chapter reference lists.

EHRlich, Paul R, EHRlich, Anne H., and HOLDREN, John P.  
Ecoscience - Population, Resources, Environment  
San Francisco: W.H. Freeman & Co. 1977  
1053 pp. Ref.

Comprehensive source book providing scientific and up-to-date information on the physical and biophysical systems of the earth, on population growth and renewable resources, and on energy and raw materials resources. The authors compile detailed materials on the various kinds of pollution and on the disruption of ecological systems. The concluding section is devoted to the discussion of social, economic and political changes necessary to respond to the problems presented.  
Annotated chapter references.

ODUM, Howard T., and ODUM, Elisabeth C.  
Energy Basis for Man and Nature  
New York: McGraw-Hill Book Company, 1976  
297 pp. Ref.

Exposition of the principles of energy and the way these shape our culture and economy. The concept of the steady-state economy is discussed in terms of low-energy economy. A language of simple, visual symbols is used to explain energy flows in economic, ecological, and technological systems.



RIFKIN, Jeremy  
Entropy - A New World View  
New York: The Viking Press, 1980  
305 pp.

Ref.

Reviews society, its history and economy, in the light of the Entropy Law. Emphasizes the contradictions that exist between the view of the earth as a closed system in terms of matter and a mechanical and linear world view based on the idea of permanent material growth. The author concludes that society is at a point of transition from a "colonizing," wasteful mode of existence to a "climactic" mode of existence where out of necessity the flow-through of energy and matter is kept at a minimum.

\* Technological Innovation

NORMAN, Colin  
The God That Limp - Science and Technology in the Eighties  
(Worldwatch Institute book)  
New York: W.W. Norton & Co., 1981  
224 pp.

Ref.

Reviews the history of technological innovation, its role for the economy and its implicit social values since WW II. Demonstrates that present investment policies for technological development reflect the needs of the postwar era and fail to recognize the social needs of the eighties. The author argues that the new technological era based on microelectronics and genetic engineering carries the promise of great benefits for society as well as the danger of social dislocation. Therefore steps have to be taken to channel R&D resources into socially productive areas.

See also: Giarini/Loubergé The Diminishing Returns of Technology  
(under 'Economics')

\* Appropriate Technology and Technology Transfer

ECKAUS, Richard S.  
Appropriate Technology for Developing Countries  
Washington: National Academy of Sciences, 1977  
140 pp.

Ref.

Examines the role of technology in developing countries to determine the contents and methods of appropriate technology decisions. Stresses the fact that the criteria for "appropriate" technological choices must be found in the essential social and economic goals of development as well as in their adaptation to a particular country

or sector. The features of development processes and their significance for appropriate technology are discussed for agriculture, small enterprise, and the service sector. Bibliography.

FARVAR, M. Taghi, and MILTON, John P. (ed.)  
The Careless Technology - Ecology and International Development  
(Record of the Conference on the Ecological Aspects of International Development in Warrenton, Virginia, 1968)  
Garden City, New York: The Natural History Press, 1972  
1030 pp. Ref.

Classic of the recent history of ecological failures accompanying the introduction of modern technology into developing countries. A comprehensive discussion of case studies gives evidence that any large-scale technology project is an ecological operation with potentially irreversible effects on human health and the ecosystem. The Conference stresses the need to abandon the reductionist approach to technological development, and to make the impact of technological intervention on the whole ecosystem the basis for decision-making. Major topics covered include irrigation and hydroelectric projects, chemical pest control in agriculture, animal husbandry and fisheries, and modern health programs.

GOULET, Denis  
The Uncertain Promise - Value Conflicts in Technology Transfer  
New York: IDOC (in cooperation with the Overseas Development Council), 1977  
320 pp. Ref.

Inquiry both on the philosophical and on the empirical level into the value conflicts in technology transfer to the developing countries. The author demonstrates how the uncritical purchase of technologies can prove to be destructive for genuine development. To harness technology to human ends, LDCs will have to construct a "vital nexus" linking their basic values, their development strategies, and their technology choices. In his conclusion, he reviews current approaches to technology in its cultural and political context. List of references.

JEQUIER, Nicolas (ed.)  
Appropriate Technology - Problems and Promises  
Paris, OECD, 1976  
345 pp. Ref.

Explores the concept and reality of appropriate technology in developing countries. In the introductory part, Jéquier suggests that the major task for developing countries is to create, nurture, and rehabilitate their internal capacity of innovation and invention, and to diffuse new types of technologies and forms of

organization suited to local conditions. He discusses the origins and meanings of appropriate technology, its information and invention systems, and the role that universities, industry, and governments can play in its development. The case studies of the second part give an insight into the successes and problems involved in the implementation of appropriate technology.

See also: Ferkiss The Future of Technological Civilization (under 'Social Organization and Political Structures')  
McRobie Small is Possible (under 'Appropriate/Intermediate Technology Information Sources - General,' Part Two)  
Schumacher Small is Beautiful (under 'Economics')

6. ETHICS, PHILOSOPHY, AND RELIGION

ANGLEMYER, Mary et al.

A Search for Environmental Ethics - An Initial Bibliography

Washington, D.C.: Smithsonian Institution Press, 1980

120 pp.

(446 citations)

An annotated bibliography for works in science, philosophy, religion, education, literature, politics, and economics that reflect the attitudes of groups and individuals towards the environment. Coverage begins with World War II.

EHRlich, Paul, and EHRlich, Anne

Extinction - The Causes and Consequences of the Disappearance of Species

New York: Random House, 1981

306 pp.

Ref.

Documents and discusses the decimation of animal species that is currently progressing at a quickening pace, due to overexploitation and the destruction of habitats. The authors emphasize the crucial importance that organic diversity has for ecological stability and advocate man's ethical obligation to respect the rights of his co-inhabitants of the earth.

PARTRIDGE, Ernest (ed.)

Responsibilities to Future Generations - Environmental Ethics

Buffalo, New York: Prometheus, 1981

319 pp.

Ref.

Anthology of contemporary philosophical essays that, based on the premise that present political and economic choices have vital implications for the future, deal with the moral obligations to posterity.

SCHELL, Jonathan

The Fate of the Earth

New York: Alfred Knopf, Inc., 1982

246 pp.

Explores up the subject of the threat of human extinction. In writing about the nuclear predicament, the author discloses the irrationality of the doctrine of deterrence and describes in detail how a nuclear holocaust would end all life on earth. He reflects on how the nuclear threat already affects our lives and how it puts into question our sense of purpose and continuity.

PART TWO: ISSUES AND EXAMPLES OF SUSTAINABLE DEVELOPMENT -  
LITERATURE ON INTEGRATED PLANNING AND LITERATURE RELEVANT TO THE  
SECTORS TO WHICH THE WORLD BANK LENDS

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A. INTEGRATED SOCIO-ECONOMIC AND ENVIRONMENTAL PLANNING AND MANAGEMENT

1. THEORY AND EXAMPLES

AHMAD, Yusuf J., and MULLER, Frank G. (ed.)  
Integrated Physical, Socio-Economic and Environmental Planning (UNEP-publ.)  
Dublin: Tycooly International Publ. Ltd., 1982.  
199 pp. Ref.

Series of papers on the issues and objectives of integrated planning and on recent country experiences. Integrated planning in general is defined as "a complex of procedures undertaken ... to accomplish a socially acceptable outcome"; it is viewed both as a framework to thought and as a technique for policymaking requiring the explicit statement of trade-offs between environmental and socio-economic goals.

CARPENTER, Richard A. (ed.)  
Assessing Tropical Forest Lands: Their Suitability for Sustainable Uses (Proceedings of the Conference on Forest Land Assessment and Management for Sustainable Uses. Honolulu, Hawaii, 1979).  
Dublin: Tycooly International Publ. Ltd., 1980  
337 pp. Ref.

A practical approach to capability classification and suitability assessment of tropical forest lands. The objective is to help land-use planners avoid misuse of land and allocate land-uses that are compatible with the ecological characteristics of the land. Rating procedures and their display in map form are presented on two levels of scale: the overview level (national, regional) and the detailed level (local). Examples from Pakistan, Sri Lanka, Japan, Malaysia, India, and New Zealand.

DASMAN, Raymond F., MILTON, John P., and FREEMAN, Peter H.  
Ecological Principles for Economic Development  
New York: John Wiley & Sons, 1974  
252 pp. Ref.

Explores the interrelationships between development and conservation and shows that both must be based on an understanding of ecology if negative side-effects are to be avoided. Emphasis is placed on the ecosystems that are presently under heavy development pressures: tropical humid forests, savannas and grasslands in tropical and

sub-tropical regions, coastal areas, and islands. Problems likely to arise from irrigation, river basin development, from forestry, livestock and agricultural projects, and from tourism are reviewed.

GARDUNO, Manuel Anaya

Technology and Desertification

In: Secretariat of the UN Conference on Desertification, Nairobi, 1977  
Desertification, its Causes and Consequences

New York, Pergamon Press, 1977

pp.319-448.

Ref.

Review of appropriate technologies and land management practices to combat desertification and to advance reclamation of desertified lands for productive uses in different land-use systems. The analysis of technologies is done according to the principal factors (water, soil, plant, animal, and energy) of the different land-use systems with the intent to take into account a great diversity of ecological, climatological, and socio-economic conditions. Bibliography.

GOVERNMENT OF ARGENTINA/OAS/UNEP

Environmental Quality and River Basin Development - A Model for  
Integrated Analysis and Planning

Washington, D.C.: Secretary-General, OAS, 1978

110 pp.

Ref.

Presents a methodology for river basin planning based on system analysis. The model shows how the evaluation of environmental impacts can be used at early planning stages. The investigations that were conducted on the possibilities of regional development in the Bermejo River Basin (Northern Argentina) from 1970 to 1975 are taken as a case study.

MacANDREWS, Colin, and SIEN, Chia Lin (ed.)

Developing Economies and the Environment - The Southeast Asian  
Experience

New York: McGraw-Hill Int. Book Co., 1970

300 pp.

Ref.

Series of reports that give an up-to-date summary of the progress made in research, environmental policy design, and resource management in the ASEAN countries. Includes contributions on resource management and pollution control programs in Thailand, Malaysia, Singapore, Indonesia, and the Philippines.

McHARG, Ian L.

Design With Nature

Garden City, New York: Doubleday/Natural History Press, 1971

198 pp.

Classic on land-use planning and land development as informed by the environmental sciences. Presents a planning and design technique that inventories and interprets environmental resources in map form which, combined, provide a basis for the spatial patterns of regional and urban growth.

NATIONAL ACADEMY OF SCIENCES/U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT  
Ecological Aspects of Development in the Humid Tropics  
Washington: National Academy Press, 1982  
297 pp. Ref.

Reviews existing scientific and technical information on agricultural and forestry management practices and resource conservation in humid tropical ecosystems for application in project planning and implementation. Discerns three major components of development that will have to be mixed to secure sustained yield: Parks and forest reserves, natural forest under intensive management, and appropriately selected and designed areas for intensive agricultural production. Appendices with data information and investigation techniques. Chapter bibliographies.

NOVOTNY, Vladimir, and CHESTERS, Gordon  
Handbook of Nonpoint Pollution - Sources and Management  
New York: Van Nostrand Reinhold, 1981  
666 pp. Ref.

Handbook for identifying area sources of pollution that are responsible for major environmental problems, and for planning and designing abatement measures and appropriate management practices. The authors discuss the causative factors of nonpoint pollution and present calculation and simulation models for assessing magnitudes of environmental damage. Land use activities, in particular urban and agricultural uses, as major nonpoint polluters are treated in detail. Extensive chapter reference lists.

THE ROYAL SWEDISH ACADEMY OF SCIENCES (ed.)  
The World's Protected Areas  
Ambio, Sept.-Oct. Issue, Vol. XI, No. 5, 1982  
323 pp  
Contact: Pergamon Press, Fairview Park, Elmsford, New York 10523

Fifteen articles on National Parks and other protected areas throughout the world. The issues of land-use planning and management are discussed and illustrated in the context of nature conservation and economic development.

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT  
Environmental Design Considerations for Rural Development Projects  
(prepared by Harza Engineering Co.)  
Washington, D.C.: U.S.AID, 1980 Ref.

Manual prepared to help rural development planners to integrate environmental considerations in the early stages of project plans involving road construction, electrification, water supply and sanitation, irrigation, and small industries. Special emphasis is placed on social and public health. Includes a checklist to assess each major project decision as to its environmental impact, and potential impact matrices for the different project components.

- (I) NATIONAL WILDLIFE FEDERATION  
1983 Conservation Directory (28th edition)  
Washington: National Wildlife Federation, 1983  
301 pp.  
Contact: National Wildlife Federation  
1412 Sixteenth Street, N.W.  
Washington, D.C. 20036

A list of national and international organizations and agencies concerned with natural resource use and management. Gives addresses, description of objectives, names of directors, and publications.

- (P) NATURAL RESOURCE TECHNICAL BULLETIN  
(published by AID/NPS Natural Resources Information Project)  
Contact: Natural Resource Technical Bulletin  
International Affairs  
National Park Service  
Washington, D.C. 20240

Bulletin on research in, and experiences with, economic activities and development that are compatible with natural resource conservation. Includes annotated reference lists on ecosystem studies and productive resource management.

- (P) RESOURCE POLICY CENTER PUBLICATIONS  
Contact: Thayer School of Engineering, Dartmouth College, Hanover,  
NH 03755

"The Resource Policy Center ... conducts research in policymaking, particularly as it applies to natural resources, energy, transportation, and the quality of the environment. Special emphasis is placed on the use of computer simulation models for policy design." (RPC- Brochure)



(P) RESOURCES FOR THE FUTURE PUBLICATIONS

Contact: 1755 Massachusetts Avenue, N.W., Washington, D.C. 20036

"RFF's studies are in the social sciences and are concerned with the relationship of people to the natural environment - the basic resources of land, water, minerals, and air, the goods and services derived from them, and the effects of production and consumption on environmental quality and human health and well-being. Because it is an important factor in every other area, energy is a particularly active concern." (RFF-Brochure)

2. ENVIRONMENTAL ECONOMICS

CARPENTER, Richard A.

Balancing Economic and Environmental Objectives: The Question is Still, How?

East-West Environment and Policy Institute, Reprint No. 38 (from: Environmental Impact Assessment Review, Vol. 2, No. 2, June 1981, pp. 175-188) Ref.

Contact: East-West Center, Honolulu, Hawaii 96848

Briefly reviews the integration of environmental assessment into developing countries' economic policy and decision-making in the 1970s. Efforts have been frustrated by the impact-oriented approach, elaborate NEPA-type procedures, and separate environmental agencies. The author discusses the changed context for environmental impact assessments in the 1980s and emphasizes that improved information and analysis methods are being devised to aid managers in balancing immediate returns against sustainable productivity.

HUFSCHMIDT, Maynard, M., and HYMAN, Eric L. (ed.)

Economic Approaches to Natural Resource and Environmental Quality Analysis

(Proceedings and Papers of a Conference on Extended Benefit-Cost Analysis, Honolulu, Hawaii, 1979)

Dublin, Ireland: Tycooly International Publ. Ltd., 1982

380 pp.

Explores the applicability of environmental economics and multiple objective planning to Third World countries. Approaches and techniques used in environmental economics are outlined and their relevance to developing countries discussed. National aspects and country experiences described for Malaysia, Indonesia, Sri Lanka, Ecuador, and Western Australia.

HUFSCHMIDT, Maynard M., JAMES, David E., MEISTER, Anton M., BOWER, Blair T., and DIXON, John A.

Environment, Natural Systems, and Development: An Economic Valuation Guide (East-West Center publication - forthcoming)

Baltimore: Johns Hopkins University Press, 1983

352 pp.

Guide to the application of different valuation techniques to changes in the natural systems and in environmental quality resulting from development activities. Extended cost-benefit analysis, environmental quality valuation from the benefit side or from the cost side, and multiple-activity economic-environmental quality models are presented as major approaches. The authors provide a basis for considering the relevance of any one technique to different economic systems and types of projects, and illustrate the techniques by case study materials.

THE WORLD BANK (Office of Environmental Affairs)  
An Annotated Bibliography of Environmental Economics  
Washington: The World Bank, 1981

26 pp.

(approx. 100 citations)

Bibliography of publications on the interfacing of natural resources and economic systems. Topics covered include cost-benefit analysis, welfare economics and techniques of analysis, evaluation of pollution effects, policy issues, and macroeconomic impacts of environmental protection. Last section on the limits-to-growth debate.

WILLIAMS, Julia

Environmental Assessment Methods, Guidelines, and Policies: A Selected Annotated Bibliography (Working Paper)

Honolulu, Hawaii: East-West Center, 1982

Contact: Environment and Policy Institute, East-West Center, Honolulu, Hawaii 96848

24 pp

(81 citations)

Selection of publications dealing with the usefulness of various assessment methods and techniques presently employed or being developed, and providing guidelines to the formulation of comprehensive environmental assessments.

B. SECTORAL LITERATURE

1. ENERGY

\* Energy Strategies

DUNKERLEY, Joy, RAMSAY, William, GORDON, Lincoln, and CECELSKI, Elizabeth  
Energy Strategies for Developing Nations (Resources for the Future publ.) Baltimore: Johns Hopkins University Press, 1981  
266 pp. Ref.  
An Overview of Energy Strategies for Developing Nations (abstract) ibid, 24 pp.

The authors see the necessity to devise strategies for the transition to an altered regime of energy supply in the oil-importing countries of the Third World. Their recommendations focus on the increase of domestic supplies, nonrenewable and renewable, the improvement of energy efficiency, and the rethinking of economic development in the light of rising energy costs. A brief review of the major directions in energy strategy as discussed in current literature is included.

HAEFELE, Wolf (program leader)  
Energy in a Finite World - Paths to a Sustainable Future  
(Report by the Energy Systems Program Group of the International Institute of Applied Systems Analysis, Laxenburg, Austria)  
Cambridge, Mass.: Ballinger Publ. Co., 1981  
Vol. 1: Summary (written by Anderer, J., et al.), 225 pp.  
Vol. 2: Complete Research Reports, 837 pp.

Comprehensive scientific analysis of the global energy system. The potential of the different energy sources to meet future demand (assumed to be three to four times higher in 2030 than in 1975) is assessed. Supply constraints, various levels of supply-demand balance, and consumptive and investive modes to use energy resources are discussed. Considers the large-scale development of both solar and nuclear energy technologies essential to achieve a sustainable energy system in the future.

LOVINS, Amory B.  
World Energy Strategy - Facts, Issues and Options  
San Francisco: Friends of the Earth, 1975  
132 pp. Ref.

Concise overview on the debate on future energy demand and possible alternatives to meet this demand. Stresses that present short-term planning will severely restrict future options.

LOVINS, Amory B.  
Soft Energy Paths - Towards a Durable Peace  
New York: Harper & Row, 1979  
232 pp.

Ref.

Discusses two possible approaches to future U.S. energy strategy that are ultimately distinguished by their socio-political implications: the "hard path" representing an extrapolation of the recent past and the "soft path" requiring slowed and eventually zero energy growth, the development of decentralized energy technologies, and the abandonment of nuclear power as a dangerous technology. Advocates the necessity and the feasibility of the latter approach.

LOVINS, Amory B, and LOVINS, Hunter L.  
Brittle Power - Energy Strategy for National Security  
Andover, Mass.: Brick House Publishing Co., 1982  
486 pp.

Ref.

Shows how the centralized energy system of the U.S. is prone to major supply disruptions and highly vulnerable to disturbances from outside - war, sabotage, natural disasters - thus representing a threat to the nation's security. The authors illustrate their views by tracing how these vulnerabilities apply to four specific cases: liquefied energy gases, oil and gas, centralized power stations, and nuclear power. They advocate the development of an alternative, more resilient energy system based on decentralization, end-use efficiency, and sustainable energy sources.

SIDDIQI, Toufiq A. (Project Coordinator)  
A Summary of Current and Planned Activities of the Project  
Environmental Dimensions of Energy Policies (Program Report, East-West Environment and Policy Institute)  
Honolulu, Hawaii: East-West Center, 1981  
21 pp.

Ref.

The goals of this project are to analyze how the natural resource and environment base affects, and is affected by, the formulation of national and international policies for energy, to review scientific and economic data that could be helpful in the formulation of energy-environment policies, and to examine the usefulness of evaluation and simulation models for energy-environment systems. Lists of workshop and conferences, 1980-81, on specific topics in energy and the environment and of project-related publications.

STOBAUGH, Robert, and YERGIN, Daniel (ed.)  
Energy Future - Report of the Energy Project at the Harvard Business School  
New York: Ballantine Books, 1979  
496 pp.

Ref.

Study on the benefits, risks, and possibilities of the different energy sources. Authors make a case for conservation as "the key energy source," for solar power, and for the reservation of hydrocarbons for premium uses. The prudent use of already existing and planned nuclear power plants is considered inevitable.

THE WORLD BANK

Energy in the Developing Countries

Washington: The World Bank, 1980

92 pp.

Ref.

Discusses the energy problem of the 1970s, and the perspective for this decade. States that by tapping reserves of oil, gas, coal, and hydroelectric and forest resources and by vigorous conservation efforts, oil-importing countries could halve their energy imports by 1990. Outlines measures for saving energy without reducing economic growth. Proposes a program for World Bank lending.

\* Renewable Energy Sources

BACH, Wilfrid, MANSHARD, Walther, MATTHEWS, William H, and BROWN, Harrison (ed.)

Renewable Energy Prospects (Proceedings of the UN University Conference on Non-fossil Fuel and Non-nuclear Fuel Energy Strategies, Honolulu, Hawaii, 1979)

New York: Pergamon Press, 1980

295 pp.

Ref.

The purpose of the Conference was to examine in detail the economic, social, health, and environmental implications of the large-scale utilization of alternative forms of energy before they are widely adopted. To set the issue in a comprehensive context, the discussion includes the consideration of short- and long-range strategies, national and international energy policies, developing and industrialized countries, and urban and rural communities.

CECELSKI, Elizabeth, DUNKERLEY, Joy, and RAMSAY, William  
Household Energy and the Poor in the Third World

Washington, D.C.: Resources for the Future, 1979

152 pp.

Ref.

Preliminary study for a research project on energy economy patterns of the poor in the developing countries. According to the findings, energy is used with great inefficiency in many parts of the Third World, and opportunities for important savings exist. The impact of cultural and institutional factors and of the distribution of income on the dissemination of new technologies is emphasized. Bibliography on existing literature and documentation.

EARTHSCAN/DEVELOPMENT FORUM

New and Renewable Energies (published for the UN Conference on New and Renewable Sources of Energy, Nairobi, Kenya, 1981)

London: Earthscan, International Institute for Environment and Development, 1981 (52 pp., 48 pp., 48 pp.)

Contact: Earthscan, 10 Percy Street, London, W1P 0DR, UK

Three booklets briefly reviewing the available resources, technologies, economics, and prospects for the energy sources under consideration at the Conference. Covers solar energies (including biomass, biogas, alcohol, firewood, and animal power) and non-solar energies (hydro, peat, oil shale, tar sand, tidal wave, ocean thermal, wind, geothermal).

GIBBONS, John H., and CHANDLER, William U.

Energy - The Conservation Revolution

New York: Plenum Press, 1981

258 pp.

Ref.

Interdisciplinary study of the value of energy conservation in building, transportation, and industry, and its technical and institutional opportunities and constraints to success. Special attention is paid to the cost-effectiveness of higher energy productivity and to the methods of "delivering" energy conservation measures. The authors base their recommendations on a critical review of recent forecasts projecting exponential growth in energy demand and on the analysis of internal and external costs of the main energy sources (including environmental and health costs). Though focusing on the U.S., a book of wider interest.

NATIONAL ACADEMY OF SCIENCES

Energy for Rural Development - Renewable Resources and Alternative Technologies for Developing Countries

Washington, D.C.: NAS, 1976

308 pp.

Ref.

Study on low-power energy sources applicable on the village level in developing countries. The first part, directed to decision-makers and planners, describes the relevant technologies and their potential. The second part, directed to the specialist, gives details on equipment, costs, recent developments, and information sources.

Supplement, ibid, 1981 (240 pp.): Information on new technologies developed after publication of original volume and on advances made in the technologies described. Bibliography on small-scale energy technologies.

TAYLOR, Robert P.  
Rural Energy Development in China  
Washington, D.C.: Resources for the Future, 1981  
276 pp. Ref.

Study and literature review of rural energy development of the last 30 years in China, which is currently leading the world in the popularization of small hydroelectric plants, small coal mines, and family-sized bio-digestors. The author blends the analysis of the technical opportunities for alternative energy sources with the examination of the institutional patterns within which they must be adopted and exploited. Extensive reference list.

THE WORLD BANK  
Renewable Energy Resources in the Developing Countries (1980,  
33 pp.)  
Mobilizing Renewable Energy Technology in Developing Countries:  
Strengthening Local Capabilities and Research (1981, 52 pp.)  
Alcohol Production from Biomass in the Developing Countries (1980,  
69 pp.)  
Washington, D.C.: The World Bank

Three publications on the potential and implementation of renewable energy programs and the role of the Bank in renewable energy development in the developing countries.

U.S. CONGRESS (Office of Technology Assessment)  
Energy from Biological Processes  
Vol. 1: *ibid*, 195 pp., Ref.  
Vol. 2: Technical and Environmental Analysis, 234 pp.  
Washington, D.C.: U.S. Government, 1980

Report evaluating the energy potential of various sources of plant and animal matter. Four biomass fuel cycles - wood, alcohol fuels, crop residues or grass and legume herbage, and animal wastes - are described, including their technical features, economics, environmental and social effects, and potential to replace conventional fuels. Policy options for their introduction into U.S. energy supplies are discussed. (Vol. 2 presents the analysis underlying Vol. 1.)

WORLDWATCH INSTITUTE  
Papers on Renewable Energy Sources:  
Energy and Architecture: The Solar and Conservation Potential  
(C. Flavin) (No. 40)  
Wood: An Ancient Fuel with a New Future (N. Smith) (No. 42)  
Rivers of Energy: The Hydropower Potential (D. Deudney) (No. 44)  
Wind Power: A Turning Point (C. Flavin) (No. 45)  
Electricity from Sunlight: The Future of Photovoltaics  
(C. Flavin) (No. 52)



Papers discussing the potential of renewable energy sources to meet future energy demands.

See also: National Academy of Sciences, Firewood Crops (under 'Agriculture, Forestry')

- (I) SMALL DECENTRALIZED HYDROPOWER PROGRAM (SDH)/NRECA:  
Publications and Updated Summaries of Activities  
Contact: 1800 Massachusetts Avenue, N.W., Washington, D.C.  
20036

Program established in May 1980 under a cooperative agreement between the National Rural Electric Cooperative Association (NRECA) and the U.S. Agency for International Development. Its objective is to enhance NRECA's technical capabilities in the area of small (1 MW or less) decentralized hydropower and to make this expertise available to developing countries. The SDH Program provides technical assistance to AID, foreign governments, and private organizations in project design and implementation.

- (P) SOFT ENERGY NOTES - Access to Tools for Soft Energy Path Studies (International Project for Soft Energy Paths publication)  
Contact: IPSEP, 124 Spear Street, San Francisco, CA 94105

Newsletter (occasionally published) of the IPSEP, that was established by the Friends of the Earth Foundation. Through its newsletter, IPSEP provides access to technical and economic data, analytic methods, and institutional concepts for appropriate technology worldwide and circulates annotated summaries of key findings to interested parties and decision-makers.

- (P) SOLAR ENERGY  
(International Journal for Scientists, Engineers, and Technologists in Solar Energy and Its Application)  
Published by The International Solar Energy Society, Victoria, Australia  
Contact: Pergamon Press, Inc.  
Maxwell House, Fairview Park, Elmsford, NY 10523

Journal with predominantly scientific and technical articles on solar energy; also on thermal and wind energy, biomass conversion, and photovoltaics.

(P) WORLD SOLAR MARKETS (A monthly briefing on renewable energy developments.)

Published by The Financial Times, London

Contact: FT Publications, Inc., 75 Rockefeller Plaza, New York, New York, 10019

Newsletter reporting on recent experiences and developments in renewable energy business (with focus on solar energy) throughout the world.

See also: Appropriate/Intermediate Technology Information Sources - General.

2. AGRICULTURE, RURAL DEVELOPMENT, AND FORESTRY

\* Ecological Agriculture

ALTIERI, Miguel A., LETOURNEAU, Deborah K., and DAVIS, James R.  
Developing Sustainable Agroecosystems  
In: BioScience, Vol. 33, No. 1, January 1983, pp. 45-49, Ref.

Article analyzing the ecological and socio-economic aspects of developing agroecosystems that are self-sustained, energy-efficient and less dependent on external resource input. Reference list.

COX, George W., and ATKINS, Michael D.  
Agricultural Ecology - An Analysis of World Food Production Systems  
San Francisco: W.H. Freeman & Co., 1979  
721 pp. Ref.

Provides a scientific basis for understanding the ecosystem concept and for applying this understanding to the development of ecologically sound agricultural practices. The authors compile extensive information on the ecological and historical context of agriculture and the intimate interrelationships of agroecosystems and natural ecosystems. To secure and increase a sustainable food production in the future, they argue, it is indispensable to design a human strategy for agriculture possessing a broad ecological rationale. Chapter reference lists.

HILL, Stuart Basic Technics in Ecological Farming  
OTT, Pierre The Maintenance of Soil Fertility  
(Proceedings of the second conference in Montreal, 1978, and the third conference in Brussels, 1980, of the International Federation of Organic Agriculture Movements)  
Basel: Birkhauser Verlag, 1982  
365 pp.  
Contact: Rodale Research Center  
R.D. 1, Box 323, Kutztown, PA 19530

At the Montreal Conference, technical papers were presented in the subject areas of agri-silviculture (temperate and tropical), legumes, organic fertilizers, animal husbandry, energy analysis, community development, training, and social factors for tropical agriculture (abstracts in English, French, and German, most papers in English).  
The Brussels Conference focused mainly on soil fertility (most papers in French).

NOVOTNY, Vladimir, and CHESTERS, Gordon (cross-reference)  
Management Practices of Nonpoint Pollution Control: Source Control  
Measures. In: ibid, Handbook of Nonpoint Pollution (see under  
'Integrated Socio-Economic and Environmental Planning and  
Management, Theory and Examples') pp. 437-458  
Ref.

Discusses management practices designed to keep soil and pollutant  
losses from agricultural lands within acceptable limits. Treats  
principal types of cropland erosion control practices including  
conservation tillage, terracing, vegetation contour strips and  
surface covers, and practices for control of pesticides losses from  
agricultural applications.

SAMPSON, R. Neil  
Farmland or Wasteland - A Time to Choose. Overcoming the Threat to  
America's Farm and Food Future  
Emmaus, Pennsylvania: Rodale Press, 1981  
422 pp. Ref.

Comprehensive study on the heavy pressures put on America's agri-  
cultural lands. Correlates issues such as the high rate of loss of  
prime farmland to other uses, accelerated soil erosion, growing  
competition for water, and increasing demand for forest products and  
new energy crops. Suggests conservation farming as a practical  
possibility and stresses the need for changes in national and local  
policies to support a sustainable instead of an exploitative farming  
system.

TILLMAN, Robert E.  
Environmental Guidelines for Irrigation (United States Man and the  
Biosphere Program and U.S. AID publication)  
74 pp. Ref.

Guidelines and environmental checklist for the identification of  
potential negative impacts resulting from irrigation projects. The  
guidelines rely on a multidisciplinary approach to irrigation  
planning, that includes the consideration of ecological, socio-  
economic, and public health factors. Annotated reference list.

U.S. CONGRESS (Office of Technology Assessment)  
Background Papers for Innovative Biological Technologies for Lesser  
Developed Countries - An Office of Technology Assessment Workshop,  
November 1980  
(Report prepared for the Committee on Foreign Affairs, U.S. House of  
Representatives)  
Washington, D.C.: U.S. Congress, 1981  
511 pp. Ref.

Provides information on biological technologies that could help developing countries to enhance soil productivity and increase food supplies while minimizing reliance on expensive chemical fertilizers, and that could contribute to the development of sustainable and productive agroecosystems. The technologies discussed include those based on underexploited plant resources, multiple cropping, biological nitrogen fixation, mycorrhizal fungi as fertilizer substitutes and the utilization of zeolites.

(P) DIVERSITY

Published by the Laboratory for Information Science in Agriculture.

Contact: 419 Canyon, Suite 320, Fort Collins, CO 80521

News journal (published bi-monthly) on plant genetic resources research and international activities in germplasm conservation.

(P) IFOAM (International Federation of Organic Agriculture Movements)

Contact: IFOAM Bulletin

Rodale Research Center, R.D. 1, Box 323,  
Kutztown, PA 19530

Quarterly of the International Federation of Organic Agriculture Movements, that was founded in 1972 to provide a link among the diverse bodies concerned with promoting and researching the ecological development of agriculture. Contains information on activities and experiences throughout the world. Literature reviews on a regular basis.

\* Small Farm Development

FREEMAN, Orville L., and KAREN, Ruth (cross-reference)

The Farmer and the Money Economy: The Role of the Private Sector in the Agricultural Development of the LDCs.

In: The Woodlands Conference, Future Roles for the Private Sector (see under 'Economics', Part One).

pp. 183-200

Winning Paper of the 1982 Mitchell Prize Competition. The authors suggest that the most effective method to increase agricultural productivity requires the involvement of the private sector, i.e., small landholders (1-5 acres) would be grouped around a corporate core which would provide technical, financial, and educational inputs and market the output. The paper offers empirical data from case histories and derives policy implications for the public and private sectors.

GILBERT, E.H., NORMAN, D.W., and WINCH, F.E.  
Farming Systems Research: A Critical Appraisal (Rural Development  
Paper No. 6).

East Lansing, Michigan: Michigan State University, 1980

135 pp.

Ref.

Contact: MSU Rural Development Papers  
Department of Agricultural Economics  
206 International Center  
Michigan State University, East Lansing, MI 48824

A state-of-the-art paper on farming systems research (FSR) in the Third World. Reviews the literature on farming systems, evaluates FSR in international institutes and in national agricultural institutions in the Third World, and recommends what can be done to expand and improve FSR in order to develop technology that is appropriate for the majority of small farmers.

HARWOOD, Richard R.

Small Farm Development - Understanding and Improving Farming Systems  
in the Humid Tropics

Boulder, Colorado: Westview Press, 1979

160 pp.

Ref.

Suggests that a combination of traditional practices and modern technologies is the key to a more successful development of the world's small farms. Discusses small farm production systems that foster efficiency in conditions of limited resources and emphasizes critical aspects at present overlooked or neglected. Includes a list of sources of information and an annotated bibliography on small farming systems.

See also: Appropriate/Intermediate Technology Information Sources -  
General

\* Forestry

CHANDLER, Trevor, and SPURGEON, David (ed.)

International Cooperation in Agroforestry (Conference in Nairobi,  
1979): German Foundation for International Development (DSE)/Inter-  
national Council for Research in Agroforestry

469 pp.

Ref.

Twenty-seven contributions on the concept and implementation of agroforestry. Agroforestry practices, in many cases derived from traditional bases, and their ecological aspects are discussed for arid and savanna ecosystems, mountain ecosystems, and the humid

tropics. The Conference stressed that agroforestry was an integrated land management system designed to provide long-term ecological stability on marginal lands while sustaining the production of food and wood. French and Spanish abstracts. Bibliography.

DOUGLAS, J. Sholto, and HART, Robert A. de J.

Forest Farming - Towards a Solution to Problems of World Hunger and Conservation

Emmaus, Pennsylvania: Rodale Press, 1978

199 pp.

Ref.

The authors argue that with the cultivation of trees, marginally productive lands and wastelands can be made productive for food supply. They present the concept of what they call "three-dimensional forest farming," the three dimensions being the trees, the harvest from the trees to feed livestock, and the animals and animal products. They discuss theory and history of forest farming and give detailed know-how for layout and operation of multiple-use forest farming schemes.

ECKHOLM, Erik P.

Losing Ground - Environmental Stress and World Food Prospects  
(Worldwatch Institute Book)

New York: W.W. Norton & Co., 1976

223 pp.

Ref.

Report on the global extent of ecological stress, its political causes and human consequences. Rampant deforestation and desertification cause the accelerating destruction of the land's productivity. To prevent ecological debacles and the irreversible undermining of the world's food production systems, the author calls for agricultural reforms, massive tree-planting campaigns and a slowdown in world population growth.

EVANS, Julian

Plantation Forestry in the Tropics

Oxford, UK: Clarendon Press, 1982

472 pp.

Ref.

Overview of plantation silviculture throughout the tropics with the purpose of setting it in the context of economic development and the wider impacts plantations have on the environment. The potential of tropical tree plantations for future world wood supply is considered very high. Part IV discusses ways of integrating plantation forestry and agriculture, the role forestry plantations can play in protective afforestation, and the conditions for sustained productivity in tropical forestry plantations. Extensive bibliography.

FOOD AND AGRICULTURE ORGANIZATION (Forestry Department)

Forestry for Local Community Development

Rome: FAO, 1978

114 pp.

Ref.

This study is an attempt to bring together existing knowledge and ideas on community forestry, which is defined as forestry activities intimately involving local people and aimed at directly benefitting the rural community. It discusses the principles of community forestry, the problems and opportunities that arise, policies and programs as well as specific production and management systems and technical considerations. Annotated reference list on community forestry and related issues.

FOOD AND AGRICULTURE ORGANIZATION  
Guidelines for Watershed Management (FAO Conservation Guide)  
Rome: FAO, 1977  
293 pp. Ref.

Eighteen papers on erosion evaluation and control methods, watershed management principles, land classification and land-use planning, slope rehabilitation by terracing, remote sensing for watershed management, and water quality measurements.

MYERS, Norman  
Conversion of Tropical Moist Forests  
Washington, D.C.: National Academy of Sciences, 1980  
205 pp. Ref.

Survey on widespread conversion patterns in tropical moist forests, in particular resulting from forest farming, timber trade, cattle raising, and firewood cutting, and their impact on these fragile ecosystems. Country-by-country documentation of the forms and degrees of tropical conversion and the efforts undertaken by governments to safeguard their tropical forest resources. Remote sensing is presented as an important device to monitor ongoing conversion trends.

NATIONAL ACADEMY OF SCIENCES  
Firewood Crops - Shrub and Tree Species for Energy Production  
Washington D.C.: NAS, 1980  
237 pp. Ref.

Detailed descriptions of fuelwood species for the humid tropics, tropical highlands, and arid and semi-arid regions. Special consideration is given to pioneer species that are particularly vigorous and adaptable, that have other uses in addition to providing fuelwood and that are characterized by nitrogen-fixing ability, rapid growth, and ability to coppice. In an introductory part, the potential and significance of fuelwood plantations as a renewable energy source, and questions of fuelwood management are treated. Appendix on efficient wood-burning devices. Selected reading list per species.



SPEARS, John

Rehabilitating Watersheds

In: Finance & Development, March 1982, pp. 30-33

Article that, based on recent World Bank experiences, reviews new approaches to watershed management and to socially oriented forestry projects in watershed areas. The key to arresting current degradation of upland catchment areas is seen in enabling small farmers to establish appropriate farming practices (for example, stall feeding, regulation of upland grazing, and contour plowing and planting) combined with physical measures to check erosion and flooding.

THE WORLD BANK

Forestry (Sector Policy Paper)

Washington, D.C.: The World Bank, 1978

67 pp

Ref.

Policy paper documenting a shift of priorities in Bank lending policy from industrial forestry towards rural development forestry and environmental forestry. The importance of afforestation projects for resource conservation and the impact of forestry projects on the welfare of indigenous people are stressed. Outlines the Bank's role in developing new concepts and packages of technology.

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT (Bureau for Development Support)

Forestry Resources Development Assistance: A Selective Bibliography of Reports

Washington, D.C.: U.S. AID, 1980

68 pp. (58 citations)

Abstracts of publications on the issues of reforestation and social forestry development in the developing countries. Includes references to general works, government policies and programs, and technical and geographical reports.

See also: Carpenter Assessing Tropical Forest Lands: Their Suitability for Sustainable Uses (under 'Integrated Socio-Economic and Environmental Planning and Management, Theory and Examples')

See also: Appropriate/Intermediate Technology Information Sources - General

\* Rural Development - Examples and Case Studies

CRITCHFIELD, Richard

Villages

New York: Anchor Press/Doubleday, 1981

388 pp.

Ref.

In the tradition of the traveler anthropologist, the author writes about peasant life in the Third World and about fundamental cultural adjustments taking place in the world's villages today. As the major elements of this change, he sees the adaptation of contraception and rising food production through modern farming practices. In summarizing his experiences, he takes a basically optimistic outlook on the future.

DIXON, Ruth B.

Rural Women at Work - Strategies for Development in South Asia  
(Resources for the Future publication)

Baltimore: Johns Hopkins Press, 1978

228 pp.

Ref.

Outlines a model for the development of producer cooperatives owned and operated by women. The model incorporates elements designed to promote rural development, improving the status of women and encouraging marriage and birth planning. Five examples of successful employment schemes for women in rural areas are described.

GOULET, Denis

Survival with Integrity - Sarvodaya at the Crossroads

Colombo, Sri Lanka: Marga Institute (in association with the Overseas Development Council, Washington), 1981

105 pp.

Ref.

Discusses the economic and political context - present and future - of the Sarvodaya Shramadana Movement in rural Sri Lanka. The author analyzes the essential value choices faced by the Movement and sees the need for it to relate itself to the national level, in particular to define its position within the process of economic growth and modernization promoted by the government. He also addresses the question whether, in spite of its heavy dependence on external aid, the movement will be able to protect its core values of self-reliance and voluntary service.

HARRISON, Paul

Inside the Third World

New York: Penguin Books, 1981 (2nd edition)

510 pp.

Ref.

Investigation of the main problems and trends as they affect the central questions of poverty and inequality. The themes explored in this context include geographical and historical roots of poverty, primitive technology, landlessness, debt, mechanization, ecological threats to agriculture, rural exodus and rapid urbanization, unemployment, overpopulation, malnutrition and disease, education, women's lot, international economy, and national political instability. Lists of recommended reading per chapter.

HARRISON, Paul

The Third World Tomorrow - A Report from the Battlefield in the War Against Poverty

New York: Penguin Books, 1980

384 pp.

Ref.

Travel reports describing how models of development involving people's participation, self-help, cooperatives, and small-scale appropriate technologies are put into practice in countries of the Third World. Gives a survey of exemplary projects for each field, such as the People's School in Bangladesh, the Preethi family planning program in Sri Lanka, or the self-built and managed townships in the Sahel, with a brief outline of the major problems to be solved.

WILDE, Ton de

Use of Technology: Rural Industrialization in Sri Lanka

Morotuwa, Sri Lanka: Sarvodaya Press, 1980

242 pp.

Ref.

Study evaluating the success of the Divisional Development Council Scheme in Sri Lanka at the national and the village level. In an introductory chapter, the dominant development theories for LDCs advocating either rapid industrialization and international trade or self-reliance and expansion of local markets are reviewed. In this context, the study aims at contributing to the latter approach by focusing the attention on the microeconomic aspects, i.e., the people and their environment, to explain success or failure in rural industrialization efforts.

### 3. EDUCATION

#### \* Innovative Learning

BOTKIN, James W., ELMANDJRA, Mahdi, and MALITZA, Mircea  
No Limits to Learning - Bridging the Human Gap (A Report to the Club  
of Rome)  
New York: Pergamon Press, 1979  
159 pp. Ref.

Reconsiders global issues such as energy, maldistribution and mal-orientation of science and technology, cultural identity, and the arms race, focusing primarily on the human element rather than on the material constraints to growth. Innovative and societal learning is seen as a prerequisite to resolving any of these issues. As an alternative to "learning by shock," the authors propose the development of "anticipatory and participatory learning".

COOMBS, Philip H., and AHMED, Manzoor  
Attacking Rural Poverty - How Informal Education Can Help  
(Prepared for The World Bank by the International Council for Educational Development)  
Baltimore: Johns Hopkins University Press, 1974  
292 pp. Ref.

Study of concepts and examples of nonformal education in developing countries. Particular attention is paid to approaches that have the potential to promote rural development, i.e., training and extension programs for small farmers, artisans, craftsmen, and small entrepreneurs, and community self-help. In their recommendations, the authors emphasize that in the development of future programs greater attention should be paid to integration, decentralization and equity.

FRIEDMAN, Yona  
Immediate Education for Survival  
In: Invention Intelligence (published by Government of India), May 1981, p. 209-215  
For information contact: Mr. Friedman, 42 Boulevard Pasteur, 75015 Paris, France

Introduction to Friedman's "Immediate Education for Survival" concept and UN project which uses simple cartoons to explain practical physics and appropriate technologies to the, often illiterate, man-in-the-street. The basic goal-oriented courses are diffused through wall-journals with the purpose of inciting people to invent a new popular technology.

PAIN, Abraham

Education and Productive Work

In: Educational Documentation and Information (Bulletin of the International Bureau of Education) 52th Year, No. 207, 2nd Quarter, Paris/Geneva: UNESCO/IBE, 1978

Issue containing the working documents and recommendations of the "Fourth Regional Conference of Ministers of Education and Those Responsible for Economic Planning in Asia and Oceania" in Colombo, 1978, and an annotated bibliography (303 citations) on the integration of production and education. Productive work undertaken as a part of education is considered an innovative approach to learning and an important opportunity in advancing self-supporting higher-level educational institutions and programs.

RENSBURG, Patrick van

The Serowe Brigades - Alternative Education in Botswana

Basingstoke/London, UK: MacMillan Education, 1978  
74 pp.

Describes the formation and educational concept of the Serowe brigades originated in 1965 as an outgrowth of Swaneng Hill School at Serowe (of which the author was Principal at that time). The 'brigades' system aims at providing employment and vocational training for a large number of primary school leavers. By combining education with production young people are given the opportunity to mobilise and create resources whilst learning, to help pay for their education. The author stresses the relevance of this type of education for rural development and its potential as a vehicle for the assimilation of new ideas and thinking.

RENSBURG, Patrick van

The Foundation for Education with Production - A New Force for Educational and Social Transformation

In: Education with Production (Journal of the Foundation for Education with Production), Vol. 1, No. 1, pp. 7-19

Contact: FEP, P.O. Box 20906, Gaborone, Botswana

Article by the co-founder of the Serowe Brigades and director of the recently established FEP. The FEP supports the transformation of education by acting as a clearing house for information and experience, by helping to establish national and regional committees for educational innovation, and by setting up its own educational projects. At the same time, it realizes that the creation of learning systems which meet the needs of the people can only be successful in cooperation with national liberation movements and workers' organizations.

\* Environmental Education

UNITED NATIONS EDUCATIONAL, SCIENTIFIC, AND CULTURAL ORGANIZATION  
Connect-UNESCO-UNEP Environmental Education Newsletter (Quarterly)  
March 82 Issue, Vol. VII, No. 1, 8 pp.  
Contact: UNESCO, 7, place Fontenoy, 75700 Paris, France

Issue summarizing the activities of the International Environmental Education Programme (IEEP) during the last seven years. The objectives of the IEEP are described on three levels: the development of a general awareness of the necessity of environmental education, the development of concepts and methodological approaches in this field, and the efforts for incorporating an environmental dimension into the educational process of UNESCO member state.

UNITED NATIONS EDUCATIONAL, SCIENTIFIC, AND CULTURAL ORGANIZATION  
(Environmental Section)  
Environmental Education

In: Educational Documentation and Information (Bulletin of the International Bureau of Education), 54th Year, No. 217, 4th Quarter, 1980. Paris/Geneva: UNESCO/IBE  
71 pp. (335 citations)

Selected and annotated bibliography of recent publications on the subject updating a former bibliography published by the IBE.

UNITED NATIONS EDUCATIONAL, SCIENTIFIC, AND CULTURAL ORGANIZATION  
Trends in Environmental Education

Paris: UNESCO, 1977  
244 pp.

Ref.

Articles presenting the nature and philosophy of environmental education and its methodological approaches at the different levels of formal and informal education. List of organizations involved in environmental education.

(I) CENTER FOR ENVIRONMENTAL EDUCATION

Directory of Environmental Education Resources - A Guide to National and International Organizations that Provide Information on the Environment

Washington: Center for Env. Ed., 1980  
55 pp.

Contact: 1925 K Street, N.W., Suite 206, Washington, D.C. 20006

Includes 279 information sources and indicates help available for eleven different areas from audiovisuals to technical

assistance and workshops. A subject guide groups the information sources under 20 different environmental interest categories.

\* Population Education

ZIMMERMAN, Margot L., and PERKIN, Gordon W.  
Print Materials for Non-Readers: Experiences in Family Planning and Health

(Program for the Introduction and Adaptation of Contraceptive Technology, PIACT, Paper 8), Seattle, 1981

39 pp.

Ref.

Contact: Canal Place, 130 Nickerson Street, Seattle, WA 98109

Paper describing the development of culturally sensitive pictorial print materials intended to inform an illiterate audience about family planning. The proposed approach has been successfully used in projects conducted by PIACT and is considered also very promising for areas of development other than family planning.

Population Education in the Schools

In: Population Reports, Series M, No. 7, March-April 1982

42 pp.

Ref.

Contact: Population Information Program  
The Johns Hopkins University  
Hampton House, 624 North Broadway, Baltimore, MD 21205

Population education, as a supplementary to family planning, is designed to teach children in school about basic population issues and, in many cases, encourage them eventually to have smaller families. The article defines the rationale of the concept, evaluates country experiences of the 1970s and addresses the topics of curriculum planning, teacher training, and teaching materials. Bibliography and list of contact addresses.

4. INDUSTRY

\* Resource Conservation and Pollution Prevention

BRUNNER, David L, MILLER, Will, and STOCKHOLM, Nan (ed.)  
The Real World of Environmental Decision Making  
Chapter 5 in: ibid, How should decisions be made?, Stanford, CA:  
Committee on Corporate Responsibility, Graduate School of Business,  
1981. pp. 81-126

Three case studies considered representative examples for companies attempting to comply with environmental laws within competitive industries. As common recommendations emerge the early public involvement in facility planning to avoid later confrontations, and a clear definition of objectives and consistent enforcement of pollution control legislation to enable rational corporate planning and compliance.

ELKINGTON, John  
The Ecology of Tomorrow's World - Industry's Environment  
London: Associated Business Press, 1980  
318 pp. Ref.

Documents how increasing consumer awareness, high prices for energy and raw materials, and stricter environmental vetting procedures on the one hand and an expanding "environmental business" on the other create a changing social and economic climate for industrial production and marketing. The author discusses the ways in which this situation will influence future industrial activities and inventories positive examples of responsible industrial management.

INTERNATIONAL CHAMBER OF COMMERCE/FEDERATION OF SWEDISH INDUSTRIES  
World Industry Conference on the Environment (Stockholm April 19-22, 1982)  
145 pp.  
Contact: United States Council for International Business  
1212 Avenue of the Americas, New York, NY 10036

The Conference was held to report on recent examples of industrial pollution abatement and to discuss how the international industrial and business community can further contribute to environmental protection and resource management. The Conference marks a general shift from purely defensive pollution control to an increasing offensive to make prevention and resource conservation profitable. Topics covered in the Conference papers include cooperation between UNEP and industry, economic aspects of environmental protection, the environmental challenge in the developing countries, and successful examples in the pulp and paper, iron and steel, chemical, food, and mining industries.



3M COMPANY

Low- or Non-Pollution Technology Through Pollution Prevention  
(Prepared for UNEP, Office of Industry and The Environment)

36 pp.

Ref.

Contact: Henry G. Owen  
Senior Public Affairs Specialist  
3M/P.O. Box 33 600, St. Paul, MN 55133

The concept of low- or non-pollution industry rests upon the elimination of the causes of pollution instead of end-of-the-line measures, the reduction of energy and raw materials inputs, and the creation of resources out of waste materials. Appropriate site selection, manufacturing integration, and programs encouraging innovative engineering design are ways to achieve industrial production that is less wasteful and less polluting. Numerous examples from different industrial branches.

THE WORLD BANK (Industrial Projects Department)  
The Potential for and Alternative Approaches to Industrial Energy Conservation in Developing Countries (in preparation)

Washington: The World Bank  
(including bibliography on energy conservation in industrial projects)

UNITED NATIONS ENVIRONMENT PROGRAMME

Industry and Environment - The Next Decade

Industry and Environment, Special Issue No. 3, 1982

Contact: UNEP, Industry and Environment Office  
17, rue Margueritte, 75017 Paris, France

63 pp.

Fifteen articles by noted politicians and businessmen on recent achievements in, and projections for, industrial production compatible with environmental protection. Country experiences (Kenya, Egypt, the Philippines, Mexico, and Nigeria) and case studies in different industrial branches are presented.

See also: Gibbon/Chandler Energy - The Conservation Revolution  
(under 'Energy, Renewable Energy Sources')  
The World Bank An Annotated Bibliography of Environmental Economics (under 'Integrated Socio-Economic and Environmental Planning and Management, Environmental Economics')

\* Product Design

OVERBY, Charles

Scarce Resources: Technology Assessment and Materials Policy: A Year with the Office of Technology Assessment (Session 1658, pp. 163-173)

Product Design for Recyclability and Life Extension (Session 2280, pp. 181-196), 1979. ASEE Annual Conference Proceedings. Ref.

Contact: American Society for Engineering Education  
11 Dupont Circle, Washington, D.C. 20036

Companion papers. Author assumes the transition of the industrialized countries towards a "conservator" society in the near future, induced by resource scarcity and limited ecological carrying capacity for wasteful consumption. Proposes changes in product design towards better recyclability, remanufacturability, and durability as important options in this direction. Governmental action to introduce technical solutions are considered indispensable and possibilities for public policies with varying degrees of enforcement are briefly explored.

PAPANEK, Victor

Design for the Real World: Human Ecology and Social Change

New York: Bantam Books, 1972

375 pp.

Ref.

Brings forth the thesis that designers should design for use and real human needs and not for style and planned obsolescence. The author provides a large number of ideas and examples of inexpensive, long-lasting, highly useful products for both the industrialized and the developing countries. Extensive bibliography.

UNIDO

Monographs on Appropriate Industrial Technology, Vols. 1 to 6

New York: United Nations, 1979

Series of monographs based on documents prepared for the UNIDO Forum on Appropriate Industrial Technology held in New Delhi in 1978. Vol. 1 covers the conceptual and policy framework for appropriate industrial technology. The remaining volumes give summary articles of current developments in low-cost transport (Vol. 2), paper and small pulp mills (Vol. 3), agricultural machinery and implements (Vol. 4), energy for rural requirements (Vol. 5), and textiles (Vol. 6).

See also: Appropriate/Intermediate Technology Information Sources - General.

5. POPULATION

CUCA, Roberto, and PIERCE, Catherine S.  
Experiments in Family Planning: Lessons from the Developing World  
(World Bank publication)  
Baltimore: The Johns Hopkins University Press, 1977  
276 pp. Ref.

Comprehensive review of ninety-six family planning experiments in developing countries and evaluation of the tested approaches. Includes a brief description of the evaluated projects and a bibliography.

McNAMARA, Robert S.  
Address to the Massachusetts Institute of Technology on the Population Problem (April 1977)  
Washington: The World Bank, 1977  
57 pp.

Analyzes the current trends in world population growth which is marked by a general decline. Discusses the factors that appear to be most influential for the reduction of fertility: health, education, broadly distributed economic growth, urbanization, and the enhanced status of women. Suggests the actions that governments and others must take to help solve the population problem.

RIDKER, Ronald (ed.)  
Population and Development - The Search for Selective Interventions  
(Resources for the Future publication)  
Baltimore: The Johns Hopkins University Press, 1976  
468 pp. Ref.

Papers by population specialists investigating probable socio-economic determinants of fertility amenable to policy manipulations and ways in which these determinants can be favorably utilized to decrease fertility. The topics selected include the effects upon fertility of income distribution, education, nutrition and health, mortality, residential location, and female employment. Bibliography.

ROSS, John A. (ed. in chief)  
International Encyclopedia of Population (Center for Population and Family Health/International Institute for the Study of Human Reproduction/Faculty of Medicine, Columbia University)  
New York: The Free Press (MacMillan Publ. Co.), 1982  
750 pp. (2 vols.) Ref.

First general summary of data and knowledge available in the field of population and population-related issues. Chapters on ecology, education, family planning, population and development, and resources and population are included. Chapter bibliographies.

THE WORLD BANK

Regional Aspects of Family Planning and Fertility Behaviour in  
Indonesia

(World Bank Staff Working Paper No. 462 by D. Chernichovski, O.A.  
Meesook)

Washington D.C.: The World Bank, 1981

63 pp.

Ref.

This paper discusses the recent decline in the population growth rate of Indonesia which has been achieved at a relatively low level of income and socio-economic development. It briefly reviews the history and organization of the family planning program in Indonesia and attempts to identify those factors which have been responsible for its success.

(I) POPLINE

Produced by the Population Information Program, Johns Hopkins University and the Library/Information Program, Center for Population and Family Health, Columbia University

Contact: Population Information Program, The Johns Hopkins University, Hampton House, 624 North Broadway, Baltimore, MD 21205

Computerized literature search service. Offers bibliographical citations and abstracts on specific subjects within the field of family planning and population. (Searches free of charge.)

See also: Zimmermann/Perkin Print Materials for Non-Readers  
Population Education in the Schools (both under 'Education,  
Population Education')

6. TRANSPORTATION

\* Urban and Intercity Road Transportation

EDWARDS, John D.

Environmental Considerations, Chapter 13 in: Homburger, Wolfgang S. (ed.), Transportation and Traffic Engineering Handbook (2nd edition, Institute of Transportation Engineers), Englewood Cliffs, New Jersey: Prentice Hall Inc., 1982  
pp. 381-415

Ref.

Discusses the various negative environmental impacts resulting from traffic (urban and intercity) and the factors influencing their magnitudes and daily variances. Also addresses traffic as a catalyst for urban sprawl. Different approaches to the control and reduction of these impacts are discussed: legal and administrative means, design and planning techniques, land-use control, multi-disciplinary facility planning, and innovative transportation modes.

SHARP, Clifford, and JENNINGS, Tony  
Transport and the Environment

Leicester University Press, 1976  
228 pp.

Ref.

Examines the impact of transportation operations on the environment. Social costs of transport -- noise, air pollution, visual intrusion, and the severance of communities -- are studied together with policies that might reduce them. The role of central and local government is considered, with particular attention to methods allowing for environmental benefits when planning new transportation investment.

THE WORLD BANK

Relieving Traffic Congestion: The Singapore Licensing Scheme  
(World Bank Staff Working Paper No. 281, by Peter L. Watson, Edward P. Holland)

Washington, D.C.: The World Bank, 1978  
286 pp.

Ref.

Report on the effects on traffic, air pollution, and people's attitudes of the Area Licensing Scheme. The scheme was introduced in Singapore in 1975 and is generally regarded as a successful attempt to reduce traffic congestion during rush hours. Besides analyzing the changes in traffic volumes and patterns, the report documents the clear abatement of carbon monoxide concentration in the air that resulted from the scheme.

See also: McHarg Design with Nature (A Step Forward - Chapter on Highway Route Selection) (under 'Integrated Socio-Economic and Environmental Planning and Management, Theory and Examples')

\* Rural Roads

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT (Office of Evaluation)  
Socio-Economic and Environmental Impacts of Low-Volume Rural Roads  
Washington D.C.: U.S. AID, 1982

Report summarizing the economic, social and environmental impacts of AID's rural road activities and the influence of rural road construction on other aspects of rural development. The working team gives recommendations how to avoid the observed problems in future projects.

See also: U.S. AID Environmental Design Considerations for Rural Development Projects (under 'Integrated Socio-Economic and Environmental Planning and Management, Theory and Examples')

See also: Appropriate/Intermediate Technology Information Sources - General

7. WATER SUPPLY/WASTE RECYCLING

\* Water Supply and Conservation/Sanitation

BAUMANN, Duane D., BOLAND, John J., SIMS, John H., KRANZER, Bonnie, and CARVER, Philip H.

The Role of Conservation in Water Supply Planning

Fort Belvoir, Virginia: U.S. Army Corps of Engineers, Institute for Water Resources, 1979.

118. pp.

Ref.

Defines water conservation as the reduction in water use or water losses that brings about a simultaneous increase in social welfare. Discusses patterns of residential, industrial, and agricultural water use and problems and opportunities for the introduction of water conservation measures. Assesses the adequacy of knowledge of the available water conservation measures and stresses the importance of an integration of water conservation planning into general water resources planning. Reference list.

BOLAND, John, DZIEGIELEWSKI, Benedykt, BAUMANN, Duane, and TURNER, Chuck

Analytical Bibliography for Water Supply and Conservation Techniques

Fort Belvoir, Virginia: U.S. Army Corps of Engineers, Institute for Water Resources, 1982

230 pp. (+Appendix A: 179 pp; 308 citations)

Information designed to assist planners in the application of the planning methodology described in The Evaluation of Water Conservation for Municipal and Industrial Water Supply: Procedures Manual developed by the U.S. Army Corps of Engineers. Appendix A contains abstracts of selected literature on water conservation planning.

RYBCZYNSKI, Witold, POLPRASERT, Chongrak, and McGARRY, Michael

Low-Cost Technology Options for Sanitation -

A State-of-the-Art Review and Annotated Bibliography

Ottawa/Washington: International Development Research Centre/The World Bank, 1978

184 pp.

Comprehensive technology review and annotated bibliography describing alternative approaches to collection, treatment, reuse, and disposal of human wastes. The propagation of adequate sanitation and sewerage is considered an indispensable complement to clean water supply.

THE WORLD BANK (Transportation, Water, and Telecommunications Department)

Appropriate Technology for Water Supply and Sanitation - Technical and Economic Options

Washington: The World Bank, 1980

124 pp.

Discusses the program planning necessary to provide socially and environmentally acceptable low-cost water supply and waste disposal. Reports on the findings of a research project on "Appropriate Technology for Water Supply and Waste Disposal in Developing Countries." (The project reviewed technologies, social/behavioral factors, economic and financial aspects, suggested technical improvements and new applications for traditional technologies, and developed selection criteria.)

TILLMAN, Gus

Environmentally Sound Small-Scale Water Projects (publ. by Coordination in Development and Volunteers in Technical Assistance)

New York: Codel, 1981

142 pp.

Ref.

Contact: VITA, 3706 Rhode Island Ave., Mt. Rainier, MD 20822

Booklet written for community development workers in developing countries who are not technicians in the area of water resources. It is meant to serve as a general guide for planning small-scale water projects which protect and conserve natural resources in a manner which allows sustainable development to take place. Specific areas covered: Sanitation and waste treatment, water and agriculture, aquatic products, water and energy.

WIJK-SIJBESMA, Christine van

Participation and Education in Community Water Supply and Sanitation Programmes: A Literature Review (Technical Paper No. 12, International Reference Centre for Community Water Supply)

Leidschendam, Netherlands, 1979

204 pp.

Contact: International Reference Centre for Community Water Supply Information Section

P.O. Box 140, 2260 AC Leidschendam, Netherlands

Water supply and sanitation projects have proved to be more successful and better maintained if the community is involved in the preparation and implementation of plans. This paper reviews conclusions from a wide literature on the subject and is a general guide to project work that involves community participation.



"Water Reuse in the Future"

(Abstracts of Papers and Poster Presentations - Water Reuse Symposium II, Washington, Twin Bridges, 1981)

221 pp.

Contact: AWWA Research Foundation  
6666 West Quincey Avenue, Denver, CO 80235

Abstracts giving a state-of-the-art of current research and projects in water reclamation and reuse in the U.S. The papers focus on the technology, economics, and institutional background of industrial, agricultural, domestic, and recreational reuses. The history of water reuse, nationally and internationally, is reviewed.

\* Resource Recovery from Solid Wastes

GUNNERSON, Charles G., and KALBERMATTEN, John M. (ed.)  
Appropriate Technology in Resource Conservation and Recovery  
(Proceedings of a session sponsored by the Research Council on Environmental Impact Analysis of the ASCE Technical Council in Atlanta, Georgia, October 1979)

New York: American Society of Civil Engineers, 1980  
214 pp. Ref.

Six contributions to the workshop addressing historical, economic, technological, institutional, and participatory aspects of municipal waste recycling. Includes reports on Asian bioconversion systems, European refuse-fired energy systems, and recent U.S. Department of Energy research on waste recycling technologies.

NAGAR, B.R.

Energy Crisis, Food Crisis, Desertification and Organic Recycling  
In: Journal of Scientific and Industrial Research (New Delhi, India), Vol. 40, No. 3, 1981  
pp. 147-153. Ref.

Suggests that organic recycling including biogas technology can help in partially solving the energy and food crisis in the developing countries. For adopting organic recycling on a large scale, a new multidisciplinary strategy is recommended. Emphasizes the necessity to study the local ecosystems to make use of the whole range of available resources and to take into consideration economic, political, and cultural constraints to find suitable recycling technologies. Bibliography on issues and technologies.

NATIONAL ACADEMY OF SCIENCES  
Food, Fuel, and Fertilizer from Organic Wastes  
Washington, D.C.: National Academy Press, 1981  
154 pp. Ref.

Report examining opportunities for the utilization of organic wastes and residues commonly found in the poorer rural areas of the world. Major technologies presented are aquaculture farming methods and fungal conversion for food production, treatment of crop residues and animal manure for feed production, biological and thermochemical waste conversion into fuel, and composting and treatment of water-borne wastes for soil improvements. Small- and large-scale integrated systems that combine several aspects of waste reuse are also described. Chapter bibliographies and research contacts.

THE WORLD BANK (Transportation, Water and Telecommunications Department)  
Resource Recovery from Municipal Solid Waste - An Annotated Bibliography (Review Copy)  
Washington, D.C.: The World Bank, 1982  
271 pp. (approx. 230 citations)

Abstracts on environmentally sound management and recycling techniques for municipal solid waste of domestic, agricultural, and industrial origin. Keyword index.

See also: Appropriate/Intermediate Technology Information Sources - General

8. URBAN DEVELOPMENT

\* Urban Planning

ARORA, Chauth Ram  
Land-Use Maps for Town Planners, in: Laconte, Paul (ed.) The Environment of Human Settlements  
(Proceedings of the Conference held in Brussels, Belgium, April 1976), Vol. 1  
New York: Pergamon Press, 1976, pp. 197-219, Ref.

Paper outlining a methodology for land-use planning based on environmental resources as exemplified at Carlisle, Mass.: Environmental resource maps depicting aspects of the geology and hydrology of Carlisle, which may affect land-use, are printed on transparent mylar. Either a single map or a combination of maps may suggest possible but mutually exclusive land-uses or a sequence of land-uses.

See also: McHarg Design With Nature  
Novotny Handbook of Nonpoint Pollution  
(both under 'Integrated Socio-Economic and Environmental Planning and Management, Theory and Examples')

\* Low-Income Housing

DAVIDSON, Forbes, and PAYNE, George  
Urban Projects Manual (prepared for the Overseas Development Administration, London; pre-publication copy)  
London: Clifford Culpin & Partners, 1980

Pragmatic guide to low-income housing projects and slum upgrading. The methodology (based on the approach to the Ismailia Projects, Egypt) integrates social and environmental concerns into project preparation and implementation.

FATHY, Hassan  
Architecture for the Poor - An Experiment in Rural Egypt  
Chicago: University of Chicago Press, 1973  
233 pp.

Describes in detail Fathy's plan for building the village of New Gournia in Egypt (in the 1940s), which was based on the adaptation of traditional building methods and space patterns, and the use of local materials. The author strongly advocates housing derived from

traditional forms of architecture, instead of imitating forms imported from the West. Also, the people themselves should be intimately involved in the design, building, and ownership of their own housing.

INTERNATIONAL DEVELOPMENT RESEARCH CENTER

Low-Income Urban Shelter Projects - An Annotated Bibliography of Research Funded by IDRC and IBRD

Ottawa/Washington: IDRC, 1982

61 pp. (126 citations)

Abstracts of the major research outputs on the evaluation by IDRC and IBRD of four of the first IBRD-financed low-income housing projects (El Salvador, Zambia, Senegal, and the Philippines). The valuation exercise was undertaken to assess the effectiveness of innovative approaches in low-income shelter and to suggest guidelines for future shelter, sites and services, and slum upgrading projects.

TURNER, Alan (ed.)

The Cities of the Poor

New York: St. Martin's Press, 1980

316 pp.

Book written by consultants in urban development in the Third World. Presents methods and techniques for the various aspects of community planning and self-help housing for low-income groups, and describes the role of the consultant in project preparation and implementation. Chapters on project planning, social needs, employment creation, administration and finance, development standards, and environmental evaluation and design.

TURNER, John F.C. and, FICHTER, Robert (ed.)

Freedom to Build

New York: MacMillan Co., 1972

301 pp.

Twelve essays examining from a variety of perspectives the participation, or lack of participation, of people in the construction and ownership of their housing, and offering concepts for self-help in housing, both for the industrialized and the developing countries. The authors contend that if dwellers lose control over their own housing, shelter becomes a commodity of reduced value to the individual and often an inordinate expense to society.

\* Low-Cost Construction

AGARVAL, Anil

Mud, Mud - The Potential of Earth-Based Materials for Third World Housing

London: Earthscan Publications

100 pp.

Ref.

Contains country surveys on the use of mud in low-income housing construction to demonstrate the potential of earth-based architecture in a variety of climates and cultures. Points out that with rising prices for conventional construction materials such as cement, mud as a traditional building material may gain in importance again, in particular if construction techniques are improved.

Low-cost Construction for the Urban Poor

The Urban Edge, May 81 Issue (Vol. 6, No. 5)

4 pp.

Issue noting new publications and projects on the subject. Particular attention is paid to the work of organizations that undertake a useful combination of research, publications, and programs in developing countries.

See also: Appropriate/Intermediate Technology Information Sources - General

C. APPROPRIATE/INTERMEDIATE TECHNOLOGY INFORMATION SOURCES - GENERAL

BRAND, Steward (ed.)  
The Next Whole Earth Catalogue: Access to Tools  
New York: Random House, 1980

Guide to basic information, resources, tools, and skills for self-sufficient and ecologically-aware lifestyles.

CARR, Marylin  
Economically Appropriate Technologies for Developing Countries - An Annotated Bibliography (Intermediate Technology Development Group publication)  
London: ITDG, 1981  
123 pp. (308 citations)

Selected publications on intermediate technologies. Intermediate technologies are considered cheaper and more labor-intensive than high technology, and in many cases more efficient than traditional methods. Gives reference lists to intermediate technologies in agriculture, low-cost housing and construction, and infrastructure. Lists of background readings, technical handbooks, and bibliographies.

DARROW, Ken, KELLER, Kent, and PAM, Rick  
Appropriate Technology Sourcebook - A Guide to Practical Books and Plans for Village and Small Community Technology  
Stanford, California: Volunteers in Asia  
Vol. I: 1978, 304 pp.  
Vol. II: 1981, 817 pp. (500 citations)  
Contact: AT Project, Volunteers in Asia, Box 4543, Stanford, CA 94305

Abstracts of a wide range of published technical information and background reading. Selected material is primarily oriented towards small-scale technology activities in poor countries. Volume II includes new topic areas: forestry, aquaculture, nonformal education, small enterprise and transportation.

McROBIE, George  
Small Is Possible (A Factual Account About Who is Doing What, Where, to Put into Practice the Ideas Expressed in E.F. Schumacher's "Small Is Beautiful")  
New York: Harper & Row, 1981  
332 pp. Ref.

Describes the formation and work of the Intermediate Technology Development Group and its counterpart organizations overseas, and the activities of alternative technology movements in Britain, the U.S.A. and Canada. The common goal of these groups is to create lifestyles

and technologies "on a human scale" that are low-cost, sparing in their use of resources, non-violent to nature and therefore sustainable. Includes Schumacher's last talk on appropriate technology for the industrialized countries. Annotated background reading list for appropriate technology in developing countries and list of organizations and information sources.

U.S. DEPARTMENT OF COMMERCE (National Technical Information Service)  
Appropriate Technology Information for the Developing Countries -  
Selected Abstracts from the NTIS Data File

Washington, D.C.: U.S. AID, 1981 (3rd edition)

484 pp.

(approx. 2,500 citations)

Contact: Terence L. Lindemann

NTIS, Office of International Affairs

5285 Port Royal Road, Room 306 YT, Springfield, VA 22161

Abstracts of publications on smaller-scale, labor-intensive, and low-cost technologies, both revived traditional and modern ones. In the context of this bibliography, appropriate technology is defined as information which can be adapted and applied to directly improve the quality of life of low-income groups.

(P) AID RESOURCES REPORT

Published by U.S. Agency for International Development

Contact: AID Resources Report, Room 209, SA-18, Bureau of Science and Technology, Washington, D.C. 20523

Bi-monthly report identifying and describing promising approaches to development. With focus on projects and research involving decentralized development and appropriate technologies.

(P) APPROPRIATE TECHNOLOGY

Intermediate Technology Publications Ltd.

Contact: ITDG, 9 King Street, London, WC2E 8HN, U.K.

Quarterly on issues, projects, and research relating to appropriate and intermediate technology in industrialized and developing countries.

(I) SOCIALLY APPROPRIATE TECHNOLOGY INFORMATION SYSTEM (SATIS)

Contact: TOOL, Mauritskade 61a, 1091 Amsterdam, Netherlands  
or: Office of Science and Technology, The World Bank

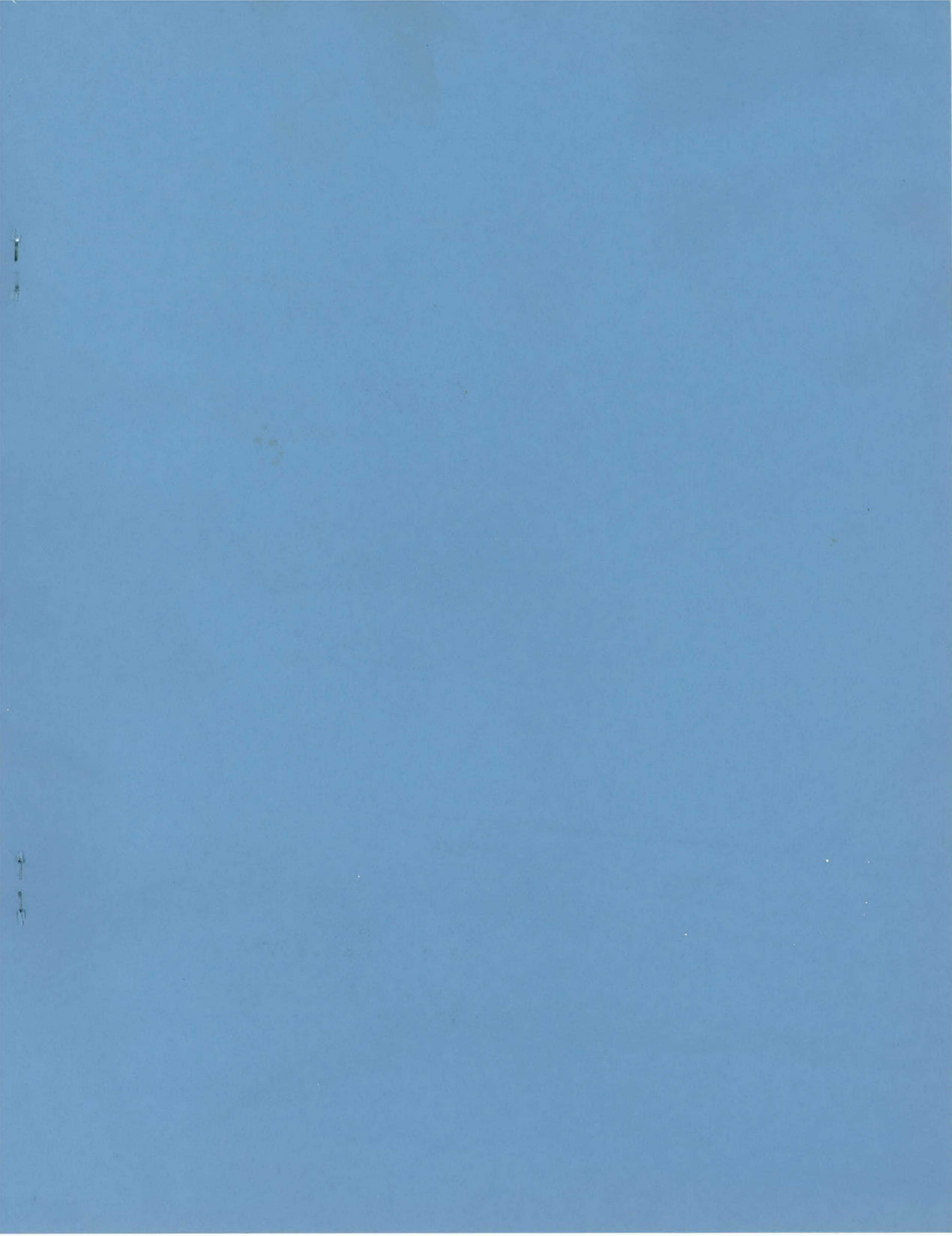
International association and information exchange system for appropriate technology. Information is classified under the headings: man and society; energy and power; water and sanitation; agriculture, forestry, and fisheries; food production; manufacture and services; building and construction works.

SATIS also publishes updated selections of appropriate technology publications. (Working languages: English, French, and Spanish).

- (P) TRANET - Transnational Network for Appropriate/Alternative Technologies  
P.O. Box 567, Rangeley, ME 04970  
(Quarterly)

"A newsletter/directory of, by and for those individuals and groups around the world who are actively developing Appropriate/Alternative Technologies." Contains annotated bibliographies on AT.







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# OFFICE MEMORANDUM

DATE April 19, 1984

TO Dr. James A. Lee

FROM Nancy Birdsall

*N. Birdsall*

EXTENSION 60001

SUBJECT WDR 1984

I thought the points you raised in your memorandum of April 6, concerning environmental issues covered in the WDR less adequately than you hoped, deserve some answer.

Your point (a) is that some increases in agricultural production are unsustainable. We do raise this as a problem, admittedly very briefly, in Chapter 1 (p. 1.9): "Such increases can contribute to overuse of natural resources, mortgaging the welfare of future generations." In Chapter 5 this is the underlying point behind the discussion of deforestation and desertification. I think in this case the specific effects tell the story better than a more general statement, and we are grateful for your help to us in preparing those sections. You may also have missed, on p. 5.5, the statement: "Parents have no choice but ... dissaving--for example, by farming their land more intensively than can be sustained in the long run."

Your point (b) is that we say nothing about the effect of rising fuel prices on future food production and food prices. When fertilizer was cheap it was not surprising that there was intensification in agriculture. Rising fertilizer prices may make it relatively cheaper to extend cultivated areas, in the U.S., Africa, Latin America. It is possible that global food supply will be a problem (see end of Box 5.3), but the evidence to date is that the problem is on the demand side--low income, as we say in the Box. The direct link from population growth to higher food prices is (surprisingly) hard to pin down in part because population growth influences supply as well as demand for food. Since it is so controversial and the evidence relatively poor, that link is not one on which we should lean--particularly given the other clear evidence of the link from rapid population growth to low income.

Your point (c) regards extinction of species. Here I think there is little evidence that population growth (as opposed to commercialization, mismanagement) is the culprit. The article you sent me by Repetto and Holmes is useful on this point. There is a more serious problem: a comprehensive report on natural resources would require development of an appropriate framework for assessing this and other environmental problems--e.g., that families and firms may rationally try to capture economic gains while shucking off to others

environmental costs. On an issue such as loss of species, the question is then whether today's private gains do or do not outweigh tomorrow's social losses. This is like the population problem, but to make the case would require more discussion of the costs of extinction of species that I felt was warranted in this WDR.

Your point (d) is that we might have recommended zero population growth. Even as a possibility, that lies several decades hence for most developing countries. I thought it inappropriate to push explicitly for a goal the additional benefits of which are hard to measure, and which is unattainable for at least 50 years anyway. We do say (p. 1.12): "In the longer run, some countries may wish to move to even lower or zero rates of population growth."

I hope you will find this WDR a good point of departure for pursuing in your own work some of the points you raise. I think the effects of misuse of natural resources on development deserves a much fuller discussion in its own right than we could provide in a report focussing on population and development. After all, many of the natural resource problems arise for reasons other than population size and growth.

cc: Messrs. Michalopoulos  
Rajagopalan

Rhoda,

Thanks for the call. Sorry, this is the attachment for memo from Lee to N. Birdsall dated Apr. 6.

Olivia

4/10/84

*file: Lee*

# Natural Resources Defense Council, Inc.

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January 24, 1984

Mr. A.W. Clausen, President  
The World Bank  
1818 H Street, N.W.  
Washington, D.C. 20433

Dear Mr. Clausen:

We are writing on behalf of eight national and international environmental organizations with over five million members in North America and the Developing World. Our concern is the World Bank Fishery Sector Policy Paper issued in December, 1982.

Bank sector policy papers have great importance for the sustainable management of natural resources, on which successful long term economic development depends. This is not only because of the very large scale of Bank lending, but also because of the policy influence the Bank exercises in borrower countries. The Bank is rightly viewed to be, in most instances, a leader among international development agencies in formulating and implementing ecologically sound policies and procedures.

Thus, we are disappointed that the Fishery Sector Policy Paper fails to mention a number of key and widely accepted principles of fisheries management or refers to them only in an indirect or overly general way. The crisis in world fisheries caused by widespread overexploitation is not addressed, and concepts such as maximum sustainable yield and an ecosystem conservation standard are not mentioned. The paper lacks the rigor which we have come to expect from official Bank statements on technical matters.

We find particularly disturbing the lack of any reference to most of the fisheries management principles set out in the World Conservation Strategy, endorsed by the President of the Bank in 1980, and in the Law of the Sea Treaty, which embodies the arduously developed consensus of almost all Bank member countries on a number of issues critical to sustainable fisheries management.

Most importantly, the paper expresses no clearly stated commitment on the Bank's part to taking specific actions in its project, country, and sector planning, and policy dialogue with

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member governments to ensure that ecologically sound management measures needed to assure sustained fishery production are effectively carried out. The Fishery Sector Policy Paper lacks the vigorous and systematic commitment to conservation set forth in policy speeches by the Bank's two most recent presidents and in the Bank signed 1980 Declaration on Environmental Policies and Procedures Relating to Development.

We respectfully request that the Bank revise the Fishery Sector Paper to incorporate these concerns. We are offering the attached comments, with specific chapter and page references, in the hope that they will be considered in such a revision. In addition, organizations with in-house fisheries expertise, such as the National Wildlife Federation, would be willing to offer more detailed comments once a revision is begun.

We suggest that in the future, draft policy papers concerning important natural resource issues be circulated more widely among environmental specialists and organizations to provide a forum for timely communication on critical ecological concerns.

Thank you very much for your attention to this matter.

Sincerely,

Thomas B. Stoel, Jr.  
Director, International Project  
Natural Resources Defense Council

Bruce M. Rich, Attorney  
International Project  
Natural Resources Defense Council

Barbara Bramble  
Director, International Program  
National Wildlife Foundation

Jack Lorenz  
Executive Director  
Izaak Walton League of America

Brent Blackwelder  
Director, Water Resources Policy Center  
Environmental Policy Center

Michael Bean  
Director, Wildlife Project  
Environmental Defense Fund

Fran Lipscomb  
Director, International Activities  
National Audubon Society

Roque Sevilla Larrea  
President, Fundacion Natura  
Quito, Ecuador

Liz Raisbeck  
Legislative Director  
Friends of the Earth, U.S.

cc: Katherine Fuller, World Wildlife Fund U.S.  
Tom Lovejoy, World Wildlife Fund U.S.  
Michael Wright, World Wildlife Fund U.S.  
1601 Connecticut Avenue, N.W.  
Washington, D.C. 20009

Mr. Ernest Stern, Senior Vice President, Operations  
Mr. S. Shahid Husain, Vice President, Operational Policy Staff  
Mr. Montague Yudelman, Director, Agriculture and Rural Development  
Mr. Visvanathan Rajagopalan, Director, Projects Policy Department  
Dr. James A. Lee, Environmental Advisor  
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Mr. James Conrow  
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The Honorable Jerry Patterson, Chairman  
Subcommittee on International Development Institutions  
and Finance  
Committee on Banking, Finance and Urban Affairs  
U.S. House of Representatives  
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Lynne Corn  
The Honorable Mike Lowry  
Member of Congress  
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COMMENTS: WORLD BANK FISHERY SECTOR POLICY PAPER

Chapter I: Status and prospects of World Fisheries.

This chapter fails to mention what we believe to be the two most important factors and policy issues concerning the status and prospects of world fisheries during the past decade: overexploitation and habitat destruction. According to the World Conservation Strategy (prepared by IUCN in collaboration with FAO and UNESCO with assistance and advice from UNEP and WWF),<sup>1/</sup> "Overfishing is the main threat to marine living resources and a significant threat to fresh-water ones" (WCS 4.4). The Strategy also notes that coastal wetlands and shallows, which provide essential habitats for two thirds of the world's fisheries, "are being destroyed the world over, with severe effects on the economies that depend on them most closely." (WCS 2.10)

Overfishing is mentioned only twice, in other chapters in the Paper, as a cause of either full exploitation of stocks or of declines in the total catch of some species (pp. 25, 40), but the real magnitude and policy implications of the problem are never addressed. Again, according to the World Conservation Strategy, "because much utilization of fisheries is not sustainable, their

<sup>1/</sup> IUCN: International Union for the Conservation of Nature and Natural Resources, Gland, Switzerland; FAO: Food and Agriculture Organization of the United Nations, Rome, Italy; UNESCO: United Nations Educational, Scientific and Cultural Organization, Paris, France; UNEP: United Nations Environment Programme, Nairobi, Kenya; WWF: World Wildlife Fund, International, Gland, Switzerland.

contribution to national diets and incomes is likely to diminish. The result of past and present overfishing is that the annual world marine catch is 15-20 million tons (or about 20%-24%) lower than it might otherwise have been, and at least 25 of the world's most valuable fisheries are seriously depleted." (WCS 4.3)

Chapter I of the Paper attributes the decline in growth of world fisheries supply in the 1970's to "the dramatic drop in the catch of anchoveta in the Pacific Ocean, off Peru and Chile." (p. 13) It does not mention the consensus expressed in the reputable scientific literature on the reasons for this fisheries debacle: overfishing and insufficient attention to ecological data (such as effects of the El Nino current) in determining and enforcing allowable yields. (see Idyll, 1973; Payne, 1977 p. 452) The chapter makes a passing reference to the possibility that "rebuilding and better management of currently depleted or heavily fished stocks (especially anchoveta and herring)" could increase world fisheries production up to 25 million metric tons (p. 12), again without either mentioning the overfishing and lack of sustained yield management which has decimated fisheries worldwide (especially anchoveta and herring). (See Payne, 1977; Idyll, 1973; May et al., 1979). More importantly, this statement and the rest of the Paper ignore growing scientific evidence that many depleted fisheries may never be rehabilitated because seriously overfished marine ecosystems often become permanently altered so that species of commercial importance are replaced in their ecological niches by other species of limited use to humans

(May et al., 1979; Payne, 1977; Idyll, 1973).

Moreover, harvesting of multi-species ecosystems such as fisheries may lead to discontinuous, "catastrophic" collapses which are counter-intuitive and irreversible. (May et al., 1979; May, 1977) "Since these catastrophic changes are seldom, if ever, predictable in a quantitative sense, and since they can be expected to occur in almost any severely exploited ecosystem, the need for conservation and contingency planning is emphasized." (May et al., 1979).

## Chapter II: Changing Conditions for World Fisheries.

The second chapter mainly focuses on issues and implications associated with establishment of 200 mile Exclusive Economic Zones (EEZs) in international law. Thus, it is all the more surprising that the Fisheries Sector Policy Paper -- a major policy document of a United Nations family institution -- should so completely ignore the relevant provisions of the Law of the Sea Treaty concerning management of fisheries in the EEZ. The United Nations Convention on the Law of the Sea (UNCLOS) represents the codification of more than a decade of high-level policy discussions concerning the management and exploitation of marine fisheries by nearly all of the participating members of the World Bank. In all probability, this treaty will have entered into force by the time many new Bank fisheries projects are ready for implementation, making the Policy Paper's disregard

of its provisions all the more distressing.

UNCLOS contains 320 articles and annexes. Two articles (56 and 57) define the EEZ and set forth the sovereign rights that pertain to it, codifying what has already become a fact under customary international law: control by coastal states of most of the fish resources of the world. More than forty additional articles, however, set forth agreed policies directly and indirectly relating to management of fisheries resources in the EEZ. Significantly, most of these provisions address environmental and ecological concerns.

In particular, Article 61 addresses the major management issues associated with exploitation of EEZ fisheries. Article 61.2 provides that each coastal state is to ensure, through proper conservation and management measures, the prevention of overexploitation of living resources in its EEZ; and Article 61.3 specifically states that coastal states shall take measures to maintain or restore populations of harvested species at levels which can produce the maximum sustainable yield (MSY). Article 61.3 includes a list of qualifying factors which coastal states can take into account in addition to MSY in setting allowable catch limits; some of these factors are economic (e.g., particular needs of coastal fishing communities) and others are environmental, such as the interdependence of stocks. Article 61.4 requires that the coastal state take into account effects on species associated with or dependent on the harvested species -- with the view that populations of dependent or associated species be maintained or restored -- at a level where their reproduction

is not seriously threatened.

The principle set forth in Article 61.4 -- sometimes referred to as an "ecosystem conservation standard" -- was incorporated into the most recent major regional fisheries convention, the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), which regulates fishing in the Southern Ocean surrounding Antarctica. This Convention has as signatories many of the world's leading fishing nations, including Japan, Chile, the USSR and Norway. With respect to Article 61, one international legal commentator noted that "What is of particular importance in these provisions is that they apply to all species, whether they are the subject of a commercial fishery or of no economic importance, and that they contain the obligation to regulate direct or indirect effects of fishing on these species so that their populations be maintained at sufficiently high a level to make their extinction impossible....(states are) bound to preserve species not for their immediate economic value but because of the role they play in the ecosystem" (de Klemm, 1981).

In as much as Article 61 sets forth management principles to prevent overexploitation, Article 62 sets forth the principle of "optimum utilization" of living resources in the EEZ so as to avoid underexploitation of resources in a hungry world. Under 62.1, states are to determine what part of the allowable catch of target species they wish to harvest in their respective EEZs, and then allow other states to harvest the remainder, provided, of course, that all states follow the strict conservation principles

set forth in Article 61.

In UNCLOS, as in the World Conservation Strategy, conservation (including conservation of non-commercial species) and optimum utilization are inextricably dependent on one another and linked: conservation is the prerequisite for rational utilization. Incredibly, this critical policy principle is never articulated in the Bank's Fishery Sector Policy Paper; conservation is mentioned only once, in Chapter 4, as a "benefit" of fisheries development rather than its sine qua non.

Moreover, an entire part of UNCLOS -- part XII -- deals with "Protection of the Marine Environment." Article 192 establishes a general obligation of states to protect the marine environment, and Article 197 obliges states to cooperate in formulating international standards, rules and practices to bring about that end. Article 194.5 provides that states take measures to protect and preserve fragile or rare marine ecosystems and the habitats of depleted or endangered marine species. Nowhere in the 79 pages of the Sector Policy Paper are these universally recognized marine ecological concerns mentioned.

In addition, both UNCLOS (Article 206) and the World Conservation Strategy emphasize the importance of environmental assessment by coastal states of all activities, land-based or marine, which may have harmful effects on the marine environment. Article 205 of UNCLOS obliges states to communicate reports of these assessments "to the competent international organizations which should make them available to all States." The Policy Paper does include (p. 45, Chapter 4) a full paragraph

on the need for a cross-sectoral approach in planning so as to take into account impacts of industrial, energy or agricultural activities on fisheries resources. However, exactly how the Bank plans to ensure this -- mandatory early environmental assessment is one of the more commonly accepted means worldwide -- is neither made clear here, nor later in the Policy Paper in Chapter 5, "The Role of the World Bank."

Finally, the Fishery Sector Policy Paper makes no mention of the growing number of Regional Seas treaties and Action Plans associated with the Regional Seas Programme of the United Nations Environment Programme (UNEP). This program has promoted a number of international agreements and protocols to address problems of environmental management and assessment in the world's major regional seas including problems associated with management and conservation of fisheries stocks and their habitats. Seas for which the littoral countries have adopted Action Plans and signed regional marine environmental management treaties include the Mediterranean, the Caribbean, the Arabian-Persian Gulf, the Red Sea and Gulf of Aden, West Africa, and the East Asian Seas.

To summarize: Chapter Two -- and the entire Fishery Sector Policy Paper -- ignores many of the major resource management issues associated with extension of the EEZ, issues which have been identified and agreed upon by the vast majority of Bank member states in UNCLOS, in regional agreements, and by the President of the Bank in 1980. These issues include adoption of a modified standard of Maximum Sustainable Yield, and/or of an "ecosystem conservation standard" to maintain or restore

harvested populations, conservation of non-target, non-harvested species dependent on marine ecosystems, optimum utilization (on a conservation base) of EEZs; and protection of habitats of depleted, rare or endangered marine species. The issues discussed in Chapter Two are limited mainly to questions of micro-economics ("the type of industry to employ; the amount to invest in supporting infrastructure," etc.) (p. 24) Reference is made to devising and enforcing regulations (p. 25) without ever mentioning the principles on which such regulations must be based. Overfishing is mentioned (pp. 24-25) as a constraint to potential development of stocks, rather than as the catastrophic consequence of past development and management based on short term micro-economic considerations instead of on scientific, biologically sustainable principles. These principles have been incorporated into the more recent international fisheries agreements such as UNCLOS and CCAMLR.

### Chapter 3: Structure and Dynamics of the Industry.

Nowhere in this chapter or in the rest of the Paper is there mention of the critical importance of intact coastal wetlands and shallows--especially mangroves and estuaries--for the economic sustainability of world fisheries, both off-shore and coastal. According to the World Conservation Strategy, the life cycles of species utilized by two-thirds of the world's fisheries are dependent on the ecological integrity of these endangered coastal



ecosystems which serve as spawning, nursery and foraging grounds (2.10). In some tropical and semi-tropical areas, such as the Gulf of Mexico, up to 97% of commercially exploited species are dependent on these habitats. The Paper's vague reference to the need for cross-sectoral planning on p. 45 is neither explicit enough nor sufficiently focused to indicate any serious and meaningful consideration of this crucial policy issue. Surely, a major objective of World Bank fisheries policy should be to ensure that non-fisheries sector projects do not destroy or harm the biological underpinnings of future fishery development.

#### Chapter 4: Development Objective, Constraints and Options.

Conservation of marine resources is described as a development objective (pp. 39-40) or benefit (p. 6) among others, along with such economic and social goals as increasing incomes and foreign exchange, and improving nutrition. But conservation is not, especially in the case of management of living resources, a post hoc benefit, nor is it only one objective among, or equivalent to, others. It is, in the words of the World Conservation Strategy, "that aspect of management which ensures that utilization is sustainable and which safeguards the ecological processes and genetic diversity -- essential for the maintenance of the resources concerned." (WCS 1.6, emphasis added)

Conservation has been recognized worldwide as the

prerequisite and first principle of natural resource development, which makes possible the sustainable realization of other objectives such as increased foreign exchange, improved nutrition, or increased incomes.

According to the World Conservation Strategy, conservation of living resources is to be achieved through the realization of three principal objectives:

1. The maintenance of essential ecological processes and life support systems (it has already been noted that, for fisheries, coastal wetlands and shallows are particularly critical habitats);
2. The preservation of genetic diversity (addressed by Articles 194.5, and 61.4 of UNCLOS);
3. Sustainable utilization of species and ecosystems (for which .....MSY and an "ecosystem conservation standard" are particularly important).

It is surprising and disappointing to find no mention of these three principles in the Chapter dealing with development objectives or anywhere else in the paper.

Moreover, the problem of incidental capture of non-target species is never raised nor addressed. Incidental take is responsible for the destruction and waste of over 7 million metric tons of fish a year (more than 10% of total world annual

fish harvests in recent years) (WCS 4.5). Several species of sea turtles are threatened with extinction through incidental catch, and incidental catch of cetaceans, especially dolphins and porpoises, is greater than intentional harvesting. Surely, the Bank should make a commitment to ensure that measures to deal with this problem be considered in its fisheries projects. These measures include modifications of fishing gear and methods, and establishment of closed seasons or protected areas for some fisheries. International agreements such as the Inter-American Tropical Tuna Convention already require the adoption of such methods.

The discussion in Chapter 4 on constraints to fisheries development also gives little consideration to the enormous importance of conservation. Mention is made only that "aggressive fishing practices can...alter the reproductive cycles of species" and that overfishing can cause problems in fisheries dealing with migratory or mobile species.

This discussion fails to point out the following fundamental constraints to fisheries development, constraints which are threats to the resource itself: overexploitation, habitat destruction, and pollution.

The options and strategy that should follow from these conservation objectives and constraints (which the paper omits) should therefore include: assurance "that the principal management goal for estuaries, mangrove swamps and other coastal wetlands and shallows critical for fisheries is the maintenance of the processes on which the fisheries depend (WCS, 5.7);

"adoption of conservative management objectives for the utilization of species and ecosystems (WCS, 7.41);" and reduction of "incidental take" as much as possible (WCS, 7.5)."

#### Chapter 5: The Role of the World Bank.

This chapter notes that the Bank will rely heavily on outside agencies -- especially FAO -- to provide technical assistance in the fisheries sector. In light of this statement, it is especially surprising that no mention is made of the World Conservation Strategy and its principles, since the WCS was prepared in collaboration with FAO, as well as endorsed by the President of the World Bank.

On the very last page there is a single paragraph which refers in very general terms to the possibility that the Bank "can" or "may" play a role in disseminating information on the environmental consequences of development projects and in promoting natural resource conservation programs or institutions. This is not the systematic and substantive commitment to the essential role of conservation in the development of natural resources that has been set forth in the speeches of the two most recent Bank presidents, the World Conservation Strategy, UNCLOS, and the 1980 New York Declaration on Environmental Policies and Procedures Relating to Development. In the recent words of the Bank's president, "... in order to be sustainable, development must include vigorous and

studied attention to resource management" (Clausen, p.10). "For sustainable development and wise conservation are, in the end, mutually reinforcing--and absolutely inseparable--goals."

(Clausen, p. 19)

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THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION  
**OFFICE MEMORANDUM**

*R - call ask for letter file: Lee*  
*being sent over.*  
*ABC*

DATE April 6, 1984

TO Ms. Nancy Birdsall, CPDRN

FROM James A. Lee, Environmental Adviser, PPDES

EXTENSION 75366

SUBJECT Comments on Fourth Draft of 1984 World Development Report

1. As noted in our earlier memo of February 15, 1984, we believe that the report has progressed significantly in addressing a number of the major environmental issues (e.g., deforestation and desertification) related to population growth. At the same time, less attention is accorded to the significant environment and population concerns that we have raised.

2. Our memo of February 15 raises environmental issues that we believe to be of major importance in any relatively comprehensive discussion of population policy. These include:

- (a) The difference between those increases in agricultural production achieved by sustainably expanding carrying capacity, versus those increases obtained temporarily, through unsustainable consumption of the capital stock of renewable natural resources.
- (b) The importance of relatively cheap fossil fuels in expanding agricultural output to date, and the extent to which future fuel price increases may limit projected increases in food production, as well as the ability of poor people to purchase such expensively-produced food.
- (c) The role of population growth in hastening the extinction of thousands of plant and animal species, due to the conversion of all of their critical natural habitats for human settlement.
- (d) The benefits for many countries of stabilizing their population size, not merely reducing their rate of growth. What are we to conclude when none of these points, elaborated in our February 15 memo and our November 1983 background paper, appear to receive significant discussion in the report.

*mentioned Ch. 5*  
*problems?*  
*def. growth*  
*shift*

3. Because the World Development Report is read by a wide audience, including much of the scientific and environmental community, significant omissions such as these could expose the Bank to otherwise unnecessary public criticism. As an example, enclosed please find a copy of a letter to President Clausen sent by a coalition of well-organized environmental NGOs. The NGOs are upset by what they view as a lack of attention to environmental concerns in the Bank's recently published Fishery Sector Policy Paper. The environmental community had earlier been vocal in their criticism of the Bank's agricultural projects and policies in hearings before the U.S. Congress. This could prove to be an obstacle to Congressional approval of IDA funding later this year.

4. We are also providing more specific comments on the enclosed marked-up, paper-clipped pages of the draft. If you have any questions concerning these comments, please contact Mr. Ledec (75370) or Mr. Goodland (75339).

5. We appreciate the opportunity to provide these suggestions, and hope that you will find them useful. Please let us know if we might be of further assistance.

Encls.

cc: Mr. V. Rajagopalan, PPDDR  
Mr. C. Michalopoulos, VPERS

G.Ledec/RGoodland:OMc



## OFFICE MEMORANDUM

file Lee

DATE March 28, 1984

TO See Distribution

FROM James A. Lee, Environmental and Scientific Adviser, PPDES

EXTENSION 75366

SUBJECT State of the World - 1984 Briefing

1. In the Fairfield Osborn Memorial Lecture delivered by the Bank's President, Mr. A. W. Clausen, in Washington, D.C. on November 12, 1981, Mr. Clausen spoke about the importance of resource management as a basis for sustainable economic development throughout the world.
2. Two weeks later, the president of the Washington-based Worldwatch Institute, Lester R. Brown, addressed a Bank-wide seminar, speaking to the subject of "Building a Sustainable Society". His book, with that title, had just been published and a number of staff members wished to meet the author. Shortly thereafter, Mr. Brown additionally briefed several senior advisers in more detail on subjects of special interest to the Bank's operations (demand management, soil and oil depletion management, population stabilization, and economic yardsticks).
3. This year the Worldwatch Institute published its first "report card" on progress in achieving a sustainable society; a book entitled "State of the World - 1984". Next year, "State of the World - 1985" will be published as the second in this new monitor series on changes in the resource base effecting the world economy; a reference source series seen as invaluable to everyone concerned with long-term global economic trends, progress, problems and opportunities. A copy of the list of contents from the 1984 edition is attached for your information, and I herewith invite you to meet the author on Friday, April 6 at 10:00 a.m. Mr. Brown will visit with us for about 1 1/2 hours in Room E-855 and has agreed to answer any questions you might have after offering us a short briefing on the report, its origin, findings, and suggested relevance to the World Bank.
4. Please inform Mrs. O. McNeal on ext. 76826 if you plan to attend this interesting briefing.

Attachment

## Distribution:

V. Rajagopalan (PPDDR); H. Adler (PPDPR); M. Selowsky (CPDDR); W. Sheldrick (INDDR); R. Stern (SVPOP); K. Marshall (EAPCA); T. Blinkhorn (IPAPA); L. R. Brown (WWI); S. Eccles (WAPDR); X. de la Renaudiere (WA2DR); C. Michalopoulos (VPERS); P. Miovic (EPDGL); U. Lele (DRDDS); M. Burney (IRDDR); A. Shakow (IRDDR); J. Grenfell (IPASU); J. Maddox (ASPAC); A. A. Sfeir-Younis (AGREP); K. Rodger/R. Saunier (OAS); Epstein (IDB); D. J. Pratt (SVPOP); N. Birdsall (CPDRM); H. Aspeqvist (VPA); G. Ledec (PPDES); D. F. Smith (EDS); J. Bharier (EGYEA); H. W. Foster (EDS); K. Kanagaratnam (PHNDR); V. W. Hogg (TRP); P. Greening (CGIAR); J. S. Spears (AGRDR); R. S. Dosik (EGYNR); C. R. Willoughby (EDIDR); S. S. Kapur (OEDOD); P. Knight (LC2DA); R. Goodland (PPDES); E. Bennathan (TRP); J. D. Shilling (EPDCO)

ROverby:OMc

STATE OF THE  
WORLD  
1984

# STATE OF THE WORLD

1984

*A Worldwatch Institute Report on  
Progress Toward a Sustainable Society*

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*Lester R. Brown*

PROJECT ASSISTANT

*Edward Wolf*

EDITOR

*Linda Starke*

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*William U. Chandler*

*Christopher Flavin*

*Sandra Postel*

W·W·NORTON & COMPANY

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## OFFICE MEMORANDUM

file Lee  
cc:CT

DATE February 15, 1984

TO Ms. N. Birdsall, CPDRM

FROM James A. Lee, PPDES

EXTENSION 75366, 75370

SUBJECT Comments on Second (1/26/84) Draft of 1984 World Development Report

1. In our view, the second draft report is a commendable beginning towards a suitable discussion of environmental and natural resource management concerns that are related to population growth. The draft makes effective use of much of the material provided by this Office in the November 1983 background paper entitled "Carrying Capacity, Population Growth, and Sustainable Development," for which we are grateful. The draft's discussion of desertification and deforestation as impediments to development is particularly thorough. We believe, moreover, that the report can be substantially strengthened by increased attention to a number of natural resource concepts and issues, discussed in the following paragraphs.
2. The draft, unfortunately, makes little or no mention of the concept of carrying capacity, and of its importance to achieving sustainable development and thereby enhancing social well-being. It does little to distinguish between those increases in agricultural (or other) production achieved by "sustainably" expanding the carrying capacity, versus those production increases achieved by short-term, overexploitation of natural resources, thereby reducing the carrying capacity. These points which are elaborated in the November 1983 background paper, would seem deserving of more attention.
3. The discussion of global food security, in Box 64 and elsewhere, is incomplete without attention to the growing scarcity of petroleum and other fossil fuels, as these non-renewable resources become depleted. By necessity, fertilizer factories have been seen to replace new land as the principal worldwide source of growth in food production. (see Brown, et al, State of the World, 1984). To the extent that future growth in food production may be constrained by rising fossil fuel prices, some of the food supply scenarios noted in the report appear questionable. Furthermore, in the absence of successful income redistribution measures, much of the food produced in the future with costly fossil fuel inputs will be unaffordably expensive to the poor. This argues forcibly that population planning measures be implemented with an even greater sense of urgency than is stressed in the report.
4. One of the more tragic consequences of development activities deriving from continued high population growth rates is the irreversible loss of the earth's biological diversity through the extirpation and extinction of thousands of plant and animal species. As described in the November 1983 background paper, such a loss can limit future development options and has important negative economic implications (as well as scientific, aesthetic, and ethical ones). Appropriate attention to this issue would strengthen the report.

5. This draft is incrementally more thorough in describing the advantages of reducing the rate of population growth in many countries. However, it does comparatively little to stress the importance of stabilizing population size. Stabilization of a country's population can serve to reduce the risk of exceeding its capacity for sustainable development; it can also increase per capita incomes and quality of life. While many Bank member countries are, admittedly, a long way from achieving population stabilization, the benefits of doing so deserve treatment in the Report.

6. In the spirit of wishing to be helpful, we hope these suggestions are useful, and look forward to working with you on future drafts of the Report.

cc: Mr. V. Rajagopalan, PPDES  
Mr. C. Michalopoulos, VPERS

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