A PRELIMINARY EXPLORATION OF
THE LINKS BETWEEN LONG-TERM ENVIRONMENTAL
MANAGEMENT AND ECONOMIC DEVELOPMENT

by
H. Jeffrey Leonard*
The Conservation Foundation
and
Woodrow Wilson School, Princeton University

Discussion Paper #104

Research Program in Development Studies
Woodrow Wilson School
Princeton University
Princeton, New Jersey

June 1982

*Paper prepared for the Research Program in Development Studies project on
Social and Political Aspects of Development, under contract with the United
States Agency for International Development.

NOTE: Discussion papers of the Research Program in Development Studies
are preliminary material circulated to stimulate discussion and critical
comment. Please do not refer to discussion papers without permission of
the authors.
INTRODUCTION

In the past several years, concern has increased that there may be long-term economic development implications associated with natural resource degradation and environmental pollution in the third world. The OECD's 1979 report *Interfutures: Facing the Future*, noted that needed increases in agricultural production in much of the world will depend on adequate soil conservation. However, the report said that "Loss of productive soil"is one of the most pressing and difficult problems facing the future of mankind."¹

Although it failed to elaborate or study the problems in any depth, the Brandt Commission's report at least acknowledged the seriousness of environmental deterioration, describing the "increasing threats to the environment and the international commons through deforestation and desertification, overfishing and overgrazing, the pollution of air and water."² As a consequence, the report noted, "A number of poor countries are threatened with the irreversible destruction of their ecological systems. . ."³

Echoing the Brandt Commission, a special *Scientific American* issue on economic development also referred to what continued resource degradation could mean for the poorest people in the poorest countries of the world:

Slim margins hedge the bare subsistence of these 1.2 billion people from disaster. Their increasing numbers endanger the fragile tropical environments in which they live. They have
cut down their forests. Lacking any water management infrastructure and so lacking adequate irrigation, they are afflicted alternately by flood and drought and suffer persistent loss of the long-term fertility of their soil to erosion and creeping deserts. These countries have had to begin to face the grim possibility that their ecosystems may not be capable of feeding their people unless measures to reverse the deterioration are taken now.

In fact, recent years have witnessed an outpouring of numerous other reports from the U.S. government, United Nations agencies, other international organizations, and private groups such as the Worldwatch Institute, all pointing out serious environmental problems in developing countries.

Even such explicit descriptions of the problems, however, tend not to be articulated as an integral part of the overall economic development outlook for developing countries. On the whole, the international development community has not given priority to the concerns being raised about the environment in developing countries. It views the mitigation of natural resource abuse and environmental degradation as secondary to the primary mission of stimulating economic development and, in particular, as antithetical to the immediate needs and interests of the lowest income countries and the poorest people in all countries. The World Bank's annual World Development Report, for example, has never addressed problems of resource management or environmental pollution in any detail; nor does it include any natural resource or environmental data in its lengthy statistical annex of development indicators in 125 countries. Certainly, there have been no
comprehensive efforts by development experts to examine resource
abuse and environmental degradation as among the most formidable hurdles
for particular developing countries in their efforts to cope with
their myriad economic problems and to achieve sustained economic
development.

In other words, a vital if underexplored question is: How do
the ecological problems facing many developing countries today interfere
with the long-term potential for economic development. How will they
affect the aspirations and efforts of these developing countries to
reach the stage where economic development is self-sustaining and the mass
of the population labors each day to increase its affluence and prosperity,
rather than to secure the minimum amount of sustenance to subsist.

Since the end of World War II, the development of the world's
underdeveloped or backward countries has become a major international
concern. Although development is generally also acknowledged to involve
a long-term process reshaping people's social, political and cultural
attitudes and institutions, it is the quest for economic improvement and
eventual prosperity that has, for obvious reasons, been the central
focus. To a degree unprecedented in history, the rich countries and
the poor countries themselves have been preoccupied with the question:
How can the poor countries of the world be made richer?

While there is less than total agreement on what it means to
get richer, most development economists agree on the reasons why countries
are poor. People, and by aggregation their countries are poor because
it takes most of their productive energies to gather, cultivate, or earn the ability to buy the provisions they need for day-to-day existence. There are many factors that hold down how much a person can produce in a day -- political repression, personal attitudes, ignorance, shortages of tools and machines, and misallocation of labor are a few. But regardless of the reason, the proximate cause of poverty in a country is the low average level of productivity.

In the early postwar years, the challenge of raising productivity was viewed primarily as one of generating large amounts of capital for investment. Tools and implements can help one person cultivate more land and harvest a greater quantity of agricultural goods. Machines and industrial equipment enable people to expand the amount and variety of goods they can produce. Increased manufacturing activity facilitated by increased capital investment also induces more people to leave agriculture -- a necessary development for improving both average and total food production in many poor regions where the marginal productivity of cultivators approaches or actually falls below zero. Capital investment also improves productive potential by providing many common property goods that open up new lands, make people and goods more mobile, and enhance workforce skills and welfare. These include investments in transportation and communication systems, numerous public works projects, facilities to generate transmissible forms of energy, and education and healthcare programs.

Since the 1950s, however, it has become increasingly clear that capital is not the only factor of production in short supply in developing countries. Many other bottlenecks have appeared which can be seen to present even greater obstacles to the attainment of a dynamic process of
economic development. Shortages of skilled labor, entrepreneurial activity, and organizational ability; numerous political, cultural, and social factors; structural aspects of the international political and economic systems; serious internal economic problems such as inflation, balance of payments, and foreign exchange availability; and population pressures are among the lengthy and ever lengthening list of obstacles to development. These obstacles thwart economic development not only by limiting capital accumulation but by inhibiting the degree to which capital available for investment is actually translated into maximizing future increases in productivity.

Although not studied as systematically as are the obstacles which have to be removed if development is to be launched at all, many theorists have also noted that other obstacles often arise after overall economic development or individual development projects have been initiated. These obstacles may lead to stagnation, decay, or collapse for projects or processes that had previously appeared to be extremely productive investments. Hirschman calls these the "forces corroding development." Among such corroding forces, the tendency of increases in production to induce offsetting increases in population (low-level equilibrium trap), the problems incurred in maintaining capital stock in working order, the matter of diminishing returns, and the creation of externalities that impinge on future economic production have been most frequently studied.
In this paper, we examine how natural resource and environmental management affect the economic prospects of poor people and poor countries. We look first at the question of how natural resource endowments may influence the choice of the overall strategy for economic development pursued by a country. In addition, we consider how long-term changes in such endowments resulting from the activities of man may influence the chances that such a strategy will succeed. Next we consider how natural resource and environmental factors may either reduce or exacerbate some of the numerous obstacles to economic development noted above. We also examine how environmental and resource degradation may be among the most debilitating of the forces that corrode economic development gains in the long-run.

We focus primarily on those resources whose productive contributions are subject to enhancement and diminishment according to the long-term management practices of man: the so-called renewable resources. We distinguish generally between two types of renewable resources: 1) those which are living and renew themselves by a process of reproduction, (biological resources); and, 2) those which provide a medium for biological resources and are continued in supply by natural processes which can be aided or inhibited by man, notably soils, water, and air, (creative resources).
The fundamental requisite for economic development is, of course, the availability of surplus capital for investment. In a closed economy, this surplus must be created by domestic savings. People must produce more than they consume and allocate the remainder for investment in the future. Participation in the international economy opens numerous other avenues for capital raising in addition to domestic savings. Raw materials and, later, finished products may be sold to other nations to generate revenues for investment. Private entrepreneurs and investors from abroad may be encouraged to transfer loans, investments or capital equipment to capital poor countries. Finally, governments from other nations or international organizations may offer specialized loan programs or outright assistance to countries in need of capital.

In practice, most developing nations rely on all of these sources to meet their capital needs. However, some countries have been able to generate much more capital internally -- domestic savings plus export earnings -- than others. In the early stages of the economic development process, the choice to emphasize domestic savings, export revenues or some combination of external assistance may be significantly influenced by a country's overall natural resource endowment.

In the early post World War II period, an important question was whether there was a link between resource endowments and national economic development and, conversely, whether underdevelopment in many countries
might be associated with such factors as adverse climate, poor soil conditions, or lack of mineral deposits and petroleum. Much of the debate about "geographic determinism." centered around the question of whether tropical climate was responsible for the relative lack of economic growth in the so-called "backward areas." In addition, others pointed out the problems of infertile soils, erratic water availability and inhospitable natural environments in many of these areas and speculated how these resource limitations might help explain low agricultural productivity and the general lack of economic development. 12

Most observers have eventually concluded that although natural resources can be an essential basis for economic development, limitations in the natural environment do not satisfactorily explain economic underdevelopment. In addition, abundant resources, most observers agree, are not sufficient in themselves to assure economic prosperity. In an era of rapidly shifting comparative advantage in industrial production, a worldwide network for transporting both raw materials and finished goods and the huge export-oriented successes of resource-poor manufacturing countries, virtually no one attempts anymore to make the case that natural resource endowments are fundamental determinants of underdevelopment and development. Indeed, in his recent book, The Nature of Mass Poverty, John Kenneth Galbraith says bluntly that the "relation of resources to well-being is so erratic as to be flatly worthless." 14

Still, students of economic development today do tend to see natural resources as an important factor for a developing country to take
into consideration in charting the best economic development strategy. Clearly, mineral and petroleum wealth can, if properly exploited, contribute significant revenues which may better enable a country to implement ambitious development plans and give a country a comparative advantage in procuring raw materials for downstream industrial development -- mineral processing, iron and steel, and petrochemicals, for example. A country with large supplies of fertile soils and fresh water may have significantly more chance over the long term of increasing domestic savings by improved agricultural productivity than a country with a fragile ecosystem and limited quantities of key renewable resources.\(^{15}\)

In addition to considering how the availability or lack of fertile soil or large mineral deposits might affect economic development, a number of economists have looked at the relationship between the supply of arable land per capita and level of economic development.\(^{16}\) But no correlation between income levels, the amount of arable land and population can be found. As Kindleberger observes, numerous pairs of countries can be found with equal incomes even though one country has nearly ten times more arable land per capita than the other.\(^{17}\) What is true, though, is that a country with more arable land per capita may have considerably more latitude for maneuvering (and making mistakes) in designing its development strategy.\(^{18}\)

Related to this issue, the question of efficient use of capital and labor in light of the availability of land and natural resources has also received a great deal of attention from economic development specialists. W. Arthur Lewis, for example, noted that many underdeveloped countries
are overpopulated relative to their natural resources and hence that
the marginal productivity of labor tends to be at or near zero. 19
Developing countries facing an unlimited supply of labor and employing
(even if marginally) the bulk of their existing natural resources present
very different investment prospectuses than the first tier of non-European
countries to experience rapid economic growth, Lewis noted:

The most productive investments are those which are made
to open up rich, easily accessible natural resources,
such as fertile soil, ores, coal or oil. This is the
principal reason why most of the capital exported in the
last hundred years went to the Americas and to Australasia
rather than to India or China, where the known resources
are already being used. 20

Such a situation of limited profit potential in resource-related invest-
ment tends to make more difficult the "natural course" of economic
development, outlined by Adam Smith, whereby "the greater part of
capital of every growing society is, first, directed to agriculture,
afterwards to manufactures, and last of all to foreign commerce." 21

However, Lewis and subsequent economists who have looked at the
challenge of development under conditions where labor is abundant
relative to resources have not concluded that this presents a fundamental
barrier to capital accumulation (the basis of economic growth). They
see, instead, the need to follow a different path to the generation of
surplus capital than the United States, where Adam Smith concluded
that "It has been the principal cause of the rapid progress of our
American colonies towards wealth and greatness that almost their whole
capitals have hitherto been employed in agriculture." 22 In contrast,
Lewis and others note, industrialization is the main hope of most labor
surplus, poor countries to increase their levels of income.
A country which may be overpopulated in the sense that there is not enough fertile, arable land to allow people to live prosperously off the land may be quite capable of increasing its income and achieving its economic development goals by concentrating its capital resources on other productive activities. An ambitious people imbued with the "will to economize" may exceed the carrying capacity of their lands by developing manufacturing or other skills which permit them to import food and create a greater surplus than could be created from agricultural production.  

The problem that many poor, labor surplus, resource-deficient countries must encounter is that of generating the initial capital surplus to fuel such a development strategy. Even with the availability of external capital sources, some resource deficient countries today are still struggling to create the surplus that will enable them to sustain economic growth beyond the level of production they can eke from their barren lands. In the meantime, paradoxically, their continued efforts to squeeze surplus production from marginal lands may only further reduce productivity, and such food imports as are necessary may erode the amount of capital that can be accumulated for necessary investments.

In a world of extensive international trade and growing demand for fuels and raw materials, another factor that can short-circuit the classical pattern of economic development outlined by Smith is the possibility
of selling abundant natural resources to other nations. Underdeveloped
countries in possession of natural resources which the rest of the world
values may face a much easier time generating capital for economic
development than countries which must depend on generating capital from
domestic savings or foreign borrowing.

The success of the petroleum exporting countries and worldwide
concern about so-called "strategic minerals" have focused international
attention on the development opportunities offered through the exploita-
tion of minerals and fossil fuels. But the possibility of creating a
"bonanza" for development also exist for countries with access to large stocks
of certain biological resources -- notably fish and timber -- and with the
capability to produce surplus agricultural goods for export. 25

As a consequence, a growing body of development planning literature
is concerned with the development and controlled exploitation of nonrenewable
and renewable resources. The most important questions are those of optimal uses
and rates of exploitation for developing countries, with the focus on
pricing, terms of trade, timing and the strategic use of proceeds for
investment in future economic production. 26

In line with the concern about strategies for exploiting non-
renewable natural resources, the economic implication of global or
national depletion of fossil fuel and mineral supply has been a matter
of periodic debate for over a century. The eminent 19th-century British
economist, W. Stanley Jevons, for example, warned that the impending
exhaustion of Britain's coal reserves would have catastrophic economic
effects, since he rightly assessed that Britain's burgeoning industrial prosperity was based on her abundant and cheap supply of coal. In reality, however, individual countries whose economies depend upon certain resources need not face economic disaster if they deplete their own fossil fuel and mineral resources, so long as world supplies remain and the country can secure access to them through political or economic means.

Barring global shortages, the dangers of domestic fossil resource depletion may be more critical for countries which export such resources than for those which import them. Even though most third world mineral exporting countries only consume small quantities of nonrenewable resources (in comparison to the industrialized countries), many depend heavily on receipts from sales of these commodities to the advanced industrial economies. Exhaustion of indigenous supplies, especially fuel supplies, could have disastrous impacts on developing economies dependent upon such revenues. As well, depletion for the sake of monetary gain now might have significant future deleterious effects for a country as it reaches the stage of industrial development when its internal demand for fuel and minerals has grown to higher levels than at present. Finally reaching the stage when it has the technological capability and capital resources to reap the higher value-added benefits from domestic processing and manufacturing of raw materials, a developing country may find that domestic supplies have already dwindled.
On the other hand, resource depletion may actually be an important element of development strategy for some developing countries. Countries may find it advantageous to maximize income from mineral exports in the short run, even if it means depleting their existing reserves, on the grounds that they can utilize the funds to create productive capital for the future. If sale of a natural resource is used to create new productive capital resources -- instead of squandered on present consumption -- the country may be better off in the long run even after supplies of the natural resource are depleted.

Sometimes, a strategy of depletion of biological resources may also be followed to a certain point in order to maximize present income and/or to create another natural resource. The best example of both may be found in the treatment of forest resources. Timber exports, just like mineral exports, may provide important revenues for financing development plans in other sectors. And the wasting of forest resources has sometimes culminated in the creation of valuable agricultural lands.

In either case, however, several ecological complications make the depletion of renewable resources somewhat trickier than depletion of nonrenewable resources. First is the question of how far depletion of forests can go before soil erosion, soil laterization, species extinction, hydrological problems, climate changes and other adverse consequences of deforestation become too costly. Second, is the problem of actually reversing behavioral patterns and economic incentives from a depletion to a sustainable yield strategy at some point in the future. Third,
the depletion of forests as a means of creating productive agricultural land is a very risky business because of the nature of forest soils.

The points to emphasize are that a) although renewable resources can be strategically depleted, at some point in time it becomes necessary to manage such resources at a level of sustainable yield production; and, b) depletion of one biological resource can also bring about undesirable and possibly irreversible degradation of resources -- especially soil and other biological resources.

To sum up, although natural resource endowments do not determine whether development does take place, they can clearly influence the best course to follow for accomplishing development. A country with fertile soil, abundant land, good climate, and available water is most likely to develop an agricultural surplus that supports growing urbanization and industrialization. Countries rich in mineral, fossil fuel, or marketable renewable resources may generate capital for economic development through the sale of these raw materials in international markets. By contrast, one that is resource poor in relation to its population may depend more on manufacturing or commerce as its motor of economic expansion. These countries may be most dependent upon external sources of capital investment to provide the initial "priming" of the economic development pump.
The long-term treatment of natural resources may be very important to the success of any of these capital-raising strategies. This is obvious in the case of countries relying upon increased agricultural production or the sales of natural resources abroad. Degradation of soil, or depletion of valuable natural resource supplies prior to the time that the economy has diversified and reached a level of self-sustaining economic growth may have serious consequences.

Long-term natural resource management is also important for resource poor nations relying on external capital. The more food these countries can produce for themselves through improving the productivity of their lands, the less it will be necessary to spend large amounts of potential investment capital on food imports.

Some of the possible influences that resource endowments and long-term resource management may have upon economic development strategy are summarized in Figure 1.
### Figure 1: Natural Resource Endowment, Resource Management and Economic Development Strategies

<table>
<thead>
<tr>
<th>I. Resource Endowment</th>
<th>II. Development Strategy</th>
<th>III. Possible Alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **I. Resource Endowment**
  - Crop yields are not equal to food requirements
  - Mean result in greater nutritional imbalance

- **II. Development Strategy**
  - Crop productivity

- **III. Possible Alternatives**
  - Crop production
  - Crop productivity
  - Crop production
Obstacles to Economic Development

Prevailing views among economists about what constitutes economic development and what steps are necessary to accomplish economic development have evolved significantly in recent decades. The metaphor of a vicious circle of poverty, in which poverty is both a result of poverty and a cause of further poverty, is still as widely used today as it was in the 1950s. But the notion that this circle can be broken by a single, concentrated take-off into sustained growth has been superceded by much more complicated models of how economic growth can best be stimulated and perpetuated in developing countries. Furthermore, no matter what the aggregate economic growth rates may be, it is now clear that poverty among the masses of people in poor countries and even in most middle-income countries is chronic and only likely to change over an extended period of decades or even generations. Few contend anymore that current economic growth rates are the best measure of economic development.

The poverty of the masses in many developing countries is chronic and self-perpetuating in part because people who are uneducated, continually undernourished, and highly susceptible to disease and even small food shortfalls generally find it difficult to muster the energy, skills, or knowledge to take steps that might bring significant and enduring changes in their welfare. The great majority of people who live at the margin are tradition-bound and conservative. They do not or cannot make investments today that will improve their lot tomorrow. They are this way out of necessity: a mistake, a bad investment, or even a delayed
pay-off may mean the difference between subsistence and famine; between relative and absolute deprivation.

Poverty in both the low-income and middle-income countries is also chronic in that it does not result only from the inability of individuals, families, villages or even whole tribes to motivate and organize themselves to make better use of the available factors of production. Underutilization of labor, misuse of resources, and unavailability of capital for investment -- whether endemic to an entire society or a function of dualistic development -- must be viewed within the context of the political and economic circumstances prevailing in nation-states and the terms under which these nation-states participate in the international system as a whole. Poor people must struggle within political systems that may allocate power or economic resources in ways that frustrate this struggle. Moreover, the degree to which the entire nation secures advantageous terms of trade and competes successfully in world markets for capital and manufactured goods may have a fundamental bearing on the fortunes of the poorest of the poor even when they participate little in their own economies.

Observers have identified numerous basic problems at the international or national level that continue to make economic development progress difficult for many developing nations. These trends have received a great deal of attention in numerous reports and studies assessing growth and development prospects in developing countries in the 1980s, and need only be briefly summarized here.
The State of the International Economy: High inflation, high unemployment and high interest rates in the industrialized countries seriously dampen the outlook for economic growth in the developing countries. Since the emergence of large-scale industrial production divided the world economy roughly into core manufacturing areas and peripheral raw material supplying areas, the velocity of economic growth in developing countries has correlated with the prevailing economic fortunes in the developed countries. When the developed world prospers, it trades more, makes available cheap credit, and offers more direct foreign aid than when times are tight. Clearly, developing country economic development prospects have suffered under the continuing stagflation plaguing the industrialized world.

In addition, rising prices in the developed countries have serious impacts on developing countries which already spend large amounts on imports of expensive machinery, advanced technology and luxury items. This is especially difficult for countries which already have balance of payments problems, depend on large doses of foreign aid, and find demand for their own exports declining as a result of stagflation in the advanced countries.

Even if future economic growth in the third world is not completely dependent on what happens in the advanced countries, it is clear that renewed growth in the developed countries will make economic growth easier in the developing countries. Until the developed nations move out from under their economic problems, the attention of the governments and peoples of the Western world
will remain focused on domestic concerns, not on providing assistance to the poorest countries and making room on world markets for the goods and raw materials trade that can help developing countries prosper.

**Barriers to Third World Industrialization:** Recent years have finally begun to see the emergence of rapid industrialization in at least some of the less developed areas of the world. Countries such as Brazil, South Korea, India, Spain, and several others in the European periphery, Southeast Asia and Latin America are fast moving into world trade circles in industries that previously fueled economic growth in the advanced countries -- textiles, steel, chemicals, even automobiles.

Future industrial expansion in many developing countries is going to be regulated by the ability of the advanced countries to absorb products from the industrializing countries and move their own economies into more diversified and sophisticated industries. Just as the postwar economic system dominated by the United States gradually permitted Europe and Japan to "make their way" by trading with the United States, so too must the present system provide the industrializing countries with such an opportunity. The problem now, however, is that growth and development in all third world countries is not deemed an overriding political goal for the United States as it was in the case of Europe and Japan. Furthermore, the ability of the advanced countries to absorb the new products is severely hampered by the persistence of economic hard times and the inability to develop rapidly alternative sectors for workers displaced by imports from industrializing countries.
These and many other external obstacles to economic development may only be marginally influenced by an individual country's ability to manage, maintain and improve productivity from its natural resource base. Still, overexploitation of natural resources, leading to depletion and degradation, may be one way that developing country governments or their populations respond in the short term to international economic constraints that limit their prospects for aid and trade. International circumstances beyond the control of an individual developing nation may significantly increase the strains already imposed on natural resource systems. This, in turn, causes or complicates other development obstacles more directly related to poor resource management and environmental deterioration. These obstacles, explored below, include: energy availability and affordability; primary export dependence; population growth and internal migrations; agricultural productivity; and fiscal policy and responsibility.

Energy Availability and Affordability: The non-petroleum producing developing countries were the hardest hit of all by the energy shockwaves of the 1970s. Most low-income countries experienced much more difficulty in adjusting to the oil price increases than the developed countries. The advanced industrial countries have managed to offset price increases at least somewhat by increased earnings from exports to oil exporters and have been the beneficiaries of large-scale recycling of petrodollars. But the responses of developing countries have been much more constrained. Virtually all of the short-term adaptations by developing countries to increased oil prices
have tended to divert investment capital from other economic development projects, to increase balance of payment and external debt problems, and to dampen economic activity by constraining the availability of energy.  

In conjunction with (and exacerbated by) the world fossil fuel crunch, another energy crisis has received increased attention in poor countries. Most people in the low-income countries depend almost entirely on traditional fuels -- especially wood, agricultural wastes and animal excreta -- for their household needs. In many areas of the developing world, serious shortages of such fuels have arisen. As a consequence, prices have increased dramatically, particularly in and around heavily populated urban areas where people cannot afford or do not have access to fossil fuels, and in areas where timber growth is relatively sparse. 

Clearly, economic development in poor countries is going to continue to be hampered so long as energy is scarce and eats up a high percentage of expenses for industrial enterprises dependent upon modern fuels and households in need of traditional fuels. In neither case, however, is there any reason to be optimistic about the short-term prospects of reducing the fiscal burdens imposed by energy scarcity or of reducing the dependence on present energy sources through substitution or technological innovation. 

Many developing countries today confront a similar dilemma to that faced in Europe during the seafaring and early industrialization era. The growing demands of LDC populations and enterprises for fuels derived directly from local biological resources has not only depleted timber supplies
but brought also many serious ecological consequences associated with
deforestation: soil erosion, disrupted hydrological cycles, depletion of
other flora and fauna dependent upon forest cover. In parts of India
and many other countries which have depleted most available forests,
people rely heavily on other biological resources, particularly animal dung,
as their chief domestic fuel. Although this may prevent further wood-
clearing, it too has serious consequences as dung is often the only source
of fertilizer for people to apply to their crops.36

Many factors have inhibited developing countries from following
the path of the West and making the transition from biological fuels to
fossil fuels in the face of increasing scarcity and growing ecological
consequences. What has happened, instead, is that most developing countries
have made a partial transition; with the segment of their industrial enter-
prises and urban economy which deals with the outside world developing a
healthy appetite for fossil fuels for industry and transportation. Thus,
many developing countries have high oil (and coal) import bills at the same
time that the masses of people and small-scale enterprises continue to
depend on local biological resources for fuel. Now, with the world price
of fossil fuels so high, and availability itself an uncertain question,
the transition is stalled if at all possible. It is highly unlikely that
rapid progress can be made to provide the masses of people in the third
world substitute fuels so that the pressures on local forest resources can
be diminished and dung can be used as fertilizer rather than for cooking.

In response to the dilemma posed by these three converging
problems -- fossil fuel affordability, biological fuel scarcity, and
ecological deterioration associated with depletion of biological resources --
developing country governments and international benefactors have in recent
years begun to mount large-scale efforts to increase the supply of available
biological resources for fuel, especially wood, and to make available
alternative sources of energy through projects to tap solar, wind, and water
power.37
Reforestation projects designed to build up huge industrial forests or village woodlots with fast growing species such as eucalyptus trees have been introduced in a large number of third world countries experiencing the pains of two energy shortages simultaneously. These projects could be of major significance for many developing countries in the future, since the economic and ecological consequences of fuel scarcities in poor countries such as those in the Sahel region of Africa are indeed massive. On the other hand, there are many political, administrative and economic factors that frequently work against the success of large schemes to create abundant and sustainable supplies of wood for energy.

Even if such woodlot projects prove to be of great success for providing fuel for home uses and a number of industrial uses, it is unlikely that the energy problems of developing countries can be solved exclusively by making available more traditional fuels. For ecological and practical reasons, no industrialized society has yet reached a level of significant per capita industrial production (by present standards) without making the transition to fossil fuels.

Brazil may be the first large industrial power to make such an attempt, relying both on its abundant forest resources and upon its technological advances in manufacturing liquid alcohol fuels from agricultural products. But, Brazil's success is by no means assured. It has already begun to face many pressures and problems associated with deforestation, as numerous international reports point out. In addition, the ecological consequences of an agriculture-for-fuels effort of the magnitude that would be necessary in Brazil could be significant. Much of the land needed would be newly conquered forest soils, which are inherently risky as we have already seen. Also, the agricultural wastes (stalks, husks, etc.) which are normally plowed back into the soil are used by alcohol production, forecasting either future soil fertility problems or, paradoxically, higher demands for petroleum based
fertilizers. It is equally as important to note that even should
Brazil succeed in becoming a highly industrialized, non-petroleum dependent
economy, the confluence of massive forest resources, large amounts of
available land and the potential for auxiliary hydropower and nuclear
power generating facilities is hardly likely to be duplicated in most
third world countries.

In sum, the energy situation in most developing countries poses
several very significant threats to their economic future. Their continued
dependence on traditional biological fuels is in many cases seriously
undermining their forest, agricultural, and water resources. The transition
to fossil fuels is either blocked or greatly slowed by world price and
scarcity. Some of the ecological and economic pressures may be removed
by management schemes to "mass produce" forests for energy. But it is unlikely
such schemes can support all the energy needs of an industrializing and
urbanizing nation in the future. The most obvious strategic answer from
an economic and ecological standpoint is for the poor developing nations to
skip directly into the post-fossil fuel energy transition by relying on
solar, wind, water, and other power generating schemes that directly tap
the undepletable rhythms of the earth. This, however, is no easily accomplished
or short-term task. For now, the answer to the developing countries'
energy problems are going to remain heavily dependent upon the institution
of far-reaching programs to cultivate and manage biological fuel sources and
small-scale technological innovations that help households and local enter-
prises use the energy supplies they have more efficiently. The extent to
which progress can be made in these two directions may have major development
and ecological implications for many developing nations in upcoming decades.

**Agricultural Productivity:** Following World War II, development planners
for third world countries were preoccupied with stimulating rapid industrial
development. Not only did few governments place significant emphasis on the
development of the agricultural sector, many (no doubt influenced by the rapid
industrialization experience of the Soviet Union) pursued policies designed
to squeeze surplus capital out of agriculture and into the industrial sector.
By the 1960s, however, an increasing number of development specialists had
begun to emphasize that, during the early stages of development, increases
in agricultural productivity were crucial to the whole development process.
Agriculture has therefore been given much greater emphasis in development
policy over the last two decades.

Some notable success in increasing agricultural production has
been achieved in key developing countries which have come to realize that a
necessary condition of economic growth is sustained increases in agricultural
production. In Taiwan and South Korea, for example, agrarian reform policies,
improved incentives for farmers, and development of irrigation and infra-
structure have gone hand in hand with large-scale industrial development.
India and several other countries, assisted by large inputs of new "Green
Revolution" technologies, while not rid their agricultural problems, have at
least managed to increase production faster than population in recent years.
And China, primarily through the mobilization of its massive human labor
potential for farming and the provision of local infrastructure (irrigation, terracing, etc.) has also developed a more stable agricultural base with which to feed its people, and contribute to industrial development. 44

In addition, some countries in recent decades have actually managed quite well by nearly foregoing land-based productivity altogether and concentrating instead on selling manufactures or essential raw materials to the world and purchasing sustenance with these revenues. The best examples from the post World War II era are city-state sized nations such as Hong Kong and Singapore and the oil-rich states of the Middle East. Still, these countries have achieved such economic growth under very special circumstances which cannot be duplicated by all underindustrialized nations. Hong Kong and Singapore, for example, have benefitted from their small sizes, and the availability of large, skilled and highly disciplined work forces living in close proximity. The Middle Eastern nations have large territories, which are rich in a commodity with a highly inelastic demand and sparsely populated.

Except for the very few nations which fit these special circumstances, it is difficult to achieve sustained economic progress and increased industrial development without making significant, simultaneous increases in productivity from the land. 45 To initiate the capital formation process that must underlie economic growth and development, a nation must produce a surplus above the subsistence level. Lacking minerals, oil or other resources to sell to external bidders, the primary source of growth capital at the early stages of a country's development must be improved agriculture production.
On balance, failures or lack of adequate attention in agriculture remain among the most fundamental problems in many developing countries today. The Brandt Commission stated that:

The first priority of food policy in developing countries, particularly in those of sub-Saharan Africa and South Asia which face the most serious deficits, is greater domestic production. Self-sufficiency is not necessarily sensible for all countries ... But if a country has two-thirds of its labor force engaged in agriculture and still cannot provide food of its own, and if it has ceased to be self-sufficient in the last two decades without any corresponding increase in cash crops or other exports to pay for imports, there is obvious cause for concern. 46

This is precisely the situation in many developing countries, particularly in sub-Saharan Africa. Indeed, data from the U.N. Food and Agricultural Organization indicate that between 1970 and 1978 food production grew more slowly than population in 58 out of 106 developing countries. 47 In countries where industrial employment is still very low, improved agricultural production is not only the main determinant of growth for the whole economy, it is the only means of improved welfare for poor people living in rural areas. People and nations who cannot afford to buy food at the market place -- by providing manufactured or other products for trade -- must at least manage to grow their own if they are to avoid serious food shortfalls and economic stagnation.

The agricultural productivity stagnation or declines occurring in many poor countries are circularly linked to endemic natural resource management
failures. The combination of rapid population growth and stagnant per capita increases in agricultural production places great pressures on poor people throughout the developing world to crop marginal areas, such as poor or dry soils, hillsides, and cleared but fragile forest soils. Although not necessarily unfarmable, many of these soils require special care and elaborate investments of labor (or capital) to construct irrigation channels, terraces, dikes, drainage ditches and other infrastructure. Yet, with an entire family's labor necessary in some parts of the developing world just to create enough agricultural surplus for an extra child, there is little opportunity to leave available land uncropped or make significant improvements to the land. Under such circumstances, the likelihood of production increases taking place -- already made difficult by population growth and various ecological constraints -- is even further diminished by declining soil productivity, nonexistent water management, and misapplication of agricultural techniques.

Of course, many observers have seen the answer to the agricultural problems of developing countries as coming from more sophisticated agricultural technologies in the form of both machines and scientific advancements. This is a debate which we need not enter here, though other observers have pointed out the energy costs and possible ecological consequences of the Green Revolution and other similar experiments in the third world.

The important point to note is that in many developing countries where national income is still heavily skewed in favor of the agriculture sector, soil erosion, soil exhaustion, aridization and desertification are leading to a situation where increasing amounts of arable lands are slipping into
the problem category. Larger doses of capital and greater portions of remedial labor are going to be necessary to maintain or increase agricultural production on these lands than would otherwise be necessary. Thus, whether a poor country tries to improve its agricultural production by capital-intensive technological innovation or by mobilizing its rural population in a labor intensive approach, continued deterioration of the land is going to make the process lengthier and more costly.

**Population Growth and Internal Migrations:** Although encouraging declines in birth rates appear to be occurring in some of the most populous developing countries (India, China, for example), rapid population growth remains a serious problem in many of the poorest countries. Moreover, even in countries where population growth rates are declining, decades of very high growth rates have altered the age structure so that a high percentage of the population is at or below peak childrearing years -- meaning that populations will inevitably continue to expand rapidly for at least several more decades. And the population problems in developing countries are not only a matter of aggregate numbers; migrations from the countryside to urban areas are swelling third world cities at even more rapid rates than overall population growth.

There is, of course, a great deal of debate among economists about the influence of rapid population growth and rural to urban migrations on economic growth. Some of the most rapidly developing countries in the
world today have population densities far higher than those that prevail in most countries of Africa and Latin America; in fact many countries on these two continents remain underpopulated in terms of their long-term industrial development needs. The problem is not overpopulation, per se. It is that in countries which are not experiencing significant economic growth, rapid population growth only increases all the other strains faced by poor people in poor countries.

Similarly, most students of economic development believe that the migration of surplus labor from the countryside is a fundamental aspect of economic development -- both for increasing agricultural productivity and for providing a pool of labor for industrial expansion. The problem in many developing countries is that high rural fertility rates mean that population in the countryside is not shrinking as it did as a result of rural-urban migration in the U.S. and Europe. And, since industrial growth is not taking place fast enough in most developing countries, the vast majority of urban migrants participate in the economy in submarginal service providing capacities rather than in industry -- a trend which does not parallel the Western development experience, where urban migrants moved overwhelmingly into industrial employment. Thus, internal migrations are creating huge social and economic distortions in developing countries but they do not appear to be "paying off" in the same way as they did in Europe and the U.S. development experience.

The environmental deterioration that is occurring in many rural areas of poor countries may have very significant bearing on the demographic problems facing these countries. Most demographers agree that fertility rates
tend to decline when wealth flows from an older generation to the younger
generation rather than, as in traditional societies, from the young to
the elders; that is, when children become an economic burden for parents rather
than a source of increased production. This transition is likely to be
slowed in areas where environmental deterioration is making marginal agricultural
production even more difficult. In response to stagnant or declining
production on available lands, labor is often the only factor of production
whose supply poor people have the capacity to increase, which they can
do by having more children. Thus, to the extent that increased numbers of
children are needed by families to work deteriorating or already deteriorated
soils, rural population growth rates are that much less likely to slow or
even level off. 51

Paradoxically, the degradation of the rural environment also can
contribute to migration into urban areas of third world countries. A number
of observers have taken note in recent years of the numbers of "ecological"
refugees fleeing eroded, deforested mountainous or arid areas where they
simply can no longer manage to maintain enough production for subsistence. 52 While
there are a great many other reasons for rural to urban migration, the
push off the land from the ravages of deforestation, soil erosion, aridization,
and declining soil fertility cannot be dismissed.

Of course, many thousands of marginal agricultural peasants were
also pushed off the land during the pre-industrial and early industrial
phases of Western Europe, though the push came more from political forces than
from ecological ones. In Europe, though, this movement contributed to
increased agricultural production, since landholdings were consolidated and
capital and labor more efficiently allocated. The problem in many third 
world areas undergoing depopulation pressures is that much of the land 
left behind is already so marginal that reclamation is going to take 
extended periods of time and large amounts of remedial care. 

Thus, the migration of people from barren, deteriorated lands does 
not open up easy opportunities to increase agricultural productivity in 
many developing countries. This only widens the rift between rural and 
urban economies and increases a country's food import needs. Already, 
the prosperity and food needs of most large third world cities are not 
organically linked with their countrysides. In very few third world 
countries is it true, as William Jennings Bryan said of the United States, 
that if the country's farms are destroyed, "grass will grow in the streets 
of every city in the country." 53 Migrants from the countryside whose 
exit does not create the supply of surplus food necessary to feed them 
in the city (because the lands they leave are so marginal or deteriorated) 
only further divorce the countrysides from the cities in developing countries.
High Dependence on Primary Exports: A large number of the low-income developing countries still depend heavily upon the revenues from one or two primary commodities to support the rest of their economy. Outside of the petroleum exporting countries, countries which still depend mainly on a small number of agricultural products, industrial raw materials, or mineral commodities have not fared well on international markets in recent years. The lack of diversification that this concentration implies has left these economies highly vulnerable to fluctuating world demand and market prices. In most cases, prices for primary commodities have declined in comparison to those for fossil fuel, capital goods, and manufactured products, which are generally the imports that must be bought by poor countries with their incomes from primary commodities. This decline in terms of trade has only increased the other economic problems facing poor countries and required them to step up exports rapidly (if possible) just to afford the same amounts of required imports.

The dangers of overspecialization, of course, vary with the elasticity of world demand for the product; oil exporting countries have obviously not suffered the same fate as zinc or sugar exporters. In addition, the tremendous revenues being reaped by advanced countries (especially the United States, Canada, and Australia) for exports of agrarian products belie the once sacred notion that terms of trade would always work in favor of industrial exports. Despite these factors, heavy specialization in primary commodities in world markets is a source of major economic instability for many developing countries.
Until many low-income countries reach a point when their economies are more diversified and flexible, they will remain subject to serious economic setback as a result of periodic fluctuations in world prices for their few exports. In the agricultural sector in particular, a country's vulnerability as a result of narrow specialization can be significantly increased by the difficult natural resource management demands that accompany monocropping.

The potential ecological dangers associated with monocropping of certain agricultural commodities without adequate crop rotation and care for the soil have been illustrated often enough in history. For example, many islands in the Atlantic and Caribbean, as well as areas on the American continents, faced severe soil degradation problems in the 17th and 18th centuries as a result of the introduction of large-scale sugar, potato, and tobacco production by European colonists. This same problem can be observed in many developing countries today where farmers are producing mainly cash crops such as ground nuts, sugar and other crops which can rapidly drain the nutrients from the soil.

Although many observers are critical, there is nothing intrinsically wrong with concentrating on one or two particular agricultural commodities, nor with cash cropping for export instead of providing a diversity of food crops for local consumption. As in the production of industrial goods, specialization in agricultural production is the secret of success in international trade. And, cash cropping can provide a country with valuable foreign exchange earnings to import both food and capital goods.
The problem is that in addition to leaving developing countries subject to external terms of trade fluctuations, specialization in one or a few cash crops also leaves countries highly susceptible to natural disasters that affect certain crops -- a particular blight or insect -- or to lapses in soil and water resource management that affect productivity over the years. In other words, the fact that many developing countries depend so heavily on a few agricultural crops for export earnings only magnifies the consequences of poor land management practices that frequently exist in the developing countries.

Fiscal Policy and Responsibility: Many developing countries have enormous difficulties in designing fiscal policies to improve economic conditions and adapt to external and internal circumstances. In part this is a matter of a shortage of trained economic specialists skilled at manipulating government taxing and spending powers. In some cases, it is also a function of a lack of sufficient funds with which to apply fiscal policy.

But the intrinsic difficulties of fiscal management have also been seriously complicated by the adverse international financial conditions described above. In response to increasing import prices -- especially for oil -- declining terms of trade for basic commodities and weak demand for third world manufactured products, most developing countries (in both the middle and low-income categories) were forced to resort to some combination of increased borrowing on foreign markets and depletion of domestic
reserves. One result is that foreign debts, both to private banks and international development assistance organizations, have skyrocketed in recent years. The problem is not so much the existence or even the size of these debts -- after all, economic growth in the United States, Canada, and Australia during the last century was in large part financed through foreign borrowing. The problem is that much of the increased borrowing, as well as current account depletion, has been in lieu of fundamental economic adjustments that must sooner or later be made.

These problems are only complicated by the fact that in many countries, scarce economic capital scraped together from foreign sources, export earnings, and meager domestic savings is not always put to the most productive uses. Development spending too often goes into unproductive investments, or into large demonstration projects that will not have major boot-strapping impacts on future economic growth. In the face of many obstacles, developing countries have found it difficult to maximize the use of current fiscal resources for creating productive capacity, jobs and surplus for investment.

Continued mismanagement of natural resources is likely to have profound fiscal impacts in the future for many poor countries. At the very least, problems such as deteriorating soil capability, silted and clogged irrigation systems, or widespread loss of forest cover will, sooner or later, require large infusions of manpower and money to prevent further deterioration or to repair past damage -- diverting scarce development funds from production-creating investments into remedial or production-preserving purposes. The failure of developing countries to pay more attention to the gradual erosion of their natural resource base today may thus vastly increase the capital costs of economic development in the future.
Moreover, projects funded by developing country governments and international lenders and donors have sometimes failed or produced vastly reduced returns as a result of poor natural resource management, or the lack of careful assessment of long-term environmental impacts.\textsuperscript{64}

Consideration of the time factor in assessing how ecological problems may inhibit economic development leads into the next section. Here we look at how natural resource degradation and environmental pollution may alter the outlook in the future for countries and specific development projects that may appear to be quite successful in the short-term.
Forces That Corrode Economic Development

Developing countries do not only have difficulty mobilizing the necessary factors of production to increase economic productivity. An equally or even more vexing challenge is that of consolidating and sustaining present gains in productivity over the long-term. Once initiated, there are no easy means of assuring that economic development can be perpetuated.

Of course, all economies -- whether developed or underdeveloped -- are subject to periodic fluctuations between prosperity and recession. But cyclical fluctuations which result from imperfections in economic markets and institutions must be differentiated from secular trends reversing or reducing over the long term previous gains made from increased productive use of natural resources or physical capital. We consider here some of the natural resource and environmental forces that may erode ongoing gains during the process of economic development.

The potentially corrosive forces which we examine fall into three broad groupings. First, are those which may affect soil fertility and thereby threaten to reverse or reduce gains made in agricultural production. The problem of maintaining soil fertility is especially central for economies based upon rainfed agriculture. Another set of erosionary forces are those which affect the ability of capital stock to continue functioning and contributing to improved production as it was designed. The long-term maintenance of irrigation systems may be one of the most difficult problems for civilizations whose agricultural productivity
is based on hydraulic agriculture. But the problem of maintaining capital stock extends beyond the agricultural sector. Virtually all physical capital -- whether infrastructure for agriculture or commerce, or machines for industry -- requires maintenance if it is to continue functioning. Finally, we look at how a wide variety of externalities generated by the process of economic development may either directly reduce the productivity of all three factors of production (labor, capital and natural resources) or require ameliorative expenditures that offset the economic gains of increased productivity.

Diminishing Returns

Present gains in agricultural production may be illusory if they are purchased at the price of long-term sustainability. In the case of medieval Europe, for example, the thirteenth and fifteenth centuries brought rapid growth in agricultural productivity, investment, urbanization, and trade that increased prosperity. However, in both cases, such progress turned out not to be self-sustaining, since it induced offsetting increases in population, and the high levels of agricultural productivity upon which it depended could not be maintained. The children of the fourteenth and sixteenth centuries paid the delayed costs of the previous centuries' prosperity, as agricultural yields declined markedly and much land that had provided ample food once before had to be abandoned to recuperate. Sustained economic progress in pre-industrial Europe was not possible until this cycle could be broken and
current food needs could be met by means other than through agricultural practices that induced periodic soil fertility declines.

This trap was integrally linked with the waves of famine, disease and depopulation that afflicted Europe periodically up through the 17th century. But it also had a marked influence on the great classical economists of the 18th and 19th centuries, who still viewed the agricultural economy as the lifeblood of economic civilization. For all the attention devoted by Smith, Malthus, Ricardo, and others to the increasing practices of urban crafts, industrial production and commercial trade, land-based production remained for these economists the fundamental means of creating the capital necessary to engage in industrial pursuits.

Looking out on a continent where population had exploded with the renewed agricultural productivity increases of the 17th century, a prime concern for these economists was how Western European countries could continue to feed an accelerating population. Although they gave markedly different assessments as to the possibilities of perpetuating economic prosperity under conditions of continued population expansion, the key limiting factor for all the classical economists was the amount of food production that could be wrought from the available supply of cultivable land without pushing Europe once again into the "medieval trap" of stagnant or declining agricultural production per capita.

Malthus believed that food production could not keep abreast with the natural rate of human reproduction and formulated his pessimistic
views of an economy which, in spite of increased agricultural production, would always be brought back to equilibrium at a subsistence level per capita.\textsuperscript{67} Ricardo, believing that all the best lands were already in production, formulated his law of diminishing returns on the assumption that future expansions of agriculture would require the use of more and more marginal lands.\textsuperscript{68} For Ricardo, the way out of the diminishing returns trap was through increased specialization and trade, not increased efforts to bring more land into production.\textsuperscript{69}

Malthus and Ricardo were both realists; they looked at the debilitating forces that had been set in motion by economic progress in previous centuries. Adam Smith, on the other hand, saw the opportunity for an economy to spin out of this cycle where equilibrium would always tend back toward the subsistence level. Much of the secondary literature on Smith emphasizes his views that growing industrial production would enable unbounded prosperity if unimpeded by the regressive interventions of government. Yet, even while stressing the profound importance of the division of labor and capital accumulation for industry in the wealth of nations, Smith pointed out that these economic activities were possible because land "produces a greater quantity of food than what is sufficient to maintain all the labour necessary for bringing it to the market."\textsuperscript{70} Consequently, Smith emphasized that "the most opulent nations, indeed, generally excel all their neighbors in agriculture as well as manufactures."\textsuperscript{71}

Like Ricardo after him, Smith saw that much of the land beyond that closest to the villages and the farmers' houses appeared marginal and scraggily.
But he took a very different view of the productive potential of this land than that which prompted Ricardo to formulate the law of diminishing returns. In essence, Smith saw the way out of the diminishing returns and low-level equilibrium trap in the application of better husbandry and more capital investment on lands that were only marginally productive.

Drawing primarily on observations in his native Scotland, Smith saw that many formerly unproductive lands had been improved in his lifetime by two key developments. First, the building of good roads and canals, "by diminishing the expense of carriage, put remote parts of the country more nearly upon a level with those in the neighborhood of the town." Second, farmers throughout Scotland had taken major new steps to introduce a system of husbandry that increased and perpetuated the productivity of vast areas of the lowlands. Key to the new husbandry techniques, Smith noted, was the extension of manuring practices which previously had only been intensively undertaken on lands closest to villages. The increased manuring resulted because of the availability of transport into the hinterlands and, even more importantly, because Scotland's entrance into a customs union with England had increased the price of cattle and thereby indirectly vastly increased the available supply of manure.

Prior to these developments, Smith described a general system of land management prevailing over the low country of Scotland in which present production consistently induced future diminishing returns. Seldom, he said, could more than a third or a fourth and often as little as a fifth or a sixth of the arable
lands be kept manured and managed and thus "kept constantly in good condition and fit for tillage."

The rest will, the greater part of them, be allowed to lie waste, producing scarce anything but some miserable pasture, just sufficient to keep alive a few straggling, half-starved cattle; the farm though much understocked in proportion to what would be necessary for its complete cultivation, being very frequently overstocked in proportion to its actual produce. A portion of this waste land, however, after having been pastured in this wretched manner for six or seven years together, may be ploughed up, when it will yield, perhaps, a poor crop or two of bad oats, or of some other coarse grain, and then, being entirely exhausted, it must be rested and pastured again as before and another portion ploughed up to be in the same manner exhausted and rested again in its turn....The rest were never manured, but a certain portion of them was in its turn, notwithstanding, regularly cultivated and exhausted. Under this system of management, it is evident, even that part of the land of Scotland which is capable of good cultivation could produce but little in comparison of what it may be capable of producing.\(^7\)

In spite of his optimistic views, then, Smith did not deny the existence of the medieval trap. In fact, he saw this as a perpetual cycle followed since time immemorial in Scotland, broken only be two very significant developments that revolutionized land management practices. One involved the provision of public goods. But the other development was the simultaneous and unplanned response of countless individuals throughout the countryside to changing economic incentives that made available large quantities of manure and rewarded improved husbandry of the land. This is an important lesson. All of the public infrastructure that permitted better access to peripheral lands and better transport to urban markets could not have by themselves brought the changes Smith observed in the Scottish countryside.
They could not have occurred if the day-in-day-out techniques of the masses who actually worked the land had not also changed to ensure continued productivity from the land. It was more than anything, the individual response to new economic incentives that broke the erratic cultivation and exhaustion cycle which for centuries had left a high percentage of the land at any given time unproductive.

Nonetheless, all pitfalls of diminishing returns on cultivated lands cannot be erased everywhere as simply as this. It is important to remember that Smith was observing lowland Scotland, an area where soils are generally good, rainfall adequate, and terrain gentle. Here, good husbandry clearly was the missing link to perpetual agricultural productivity. In many developing countries today, the problem is that additional lands available for cultivation truly are more marginal than those already under cultivation.

Indeed, one of the reasons Ricardo presented a more pessimistic view on this matter than Smith was probably that by his time new husbandry techniques of the sort Smith lauded were being maximally applied on the best lands of the United Kingdom and the rest of Europe. Given equal doses of capital and labor (even labor employing careful husbandry techniques) Ricardo saw that lands in marshy areas, having poor soils, in sloping terrain, or with decreased water availability would yield less production than the flat, fertile lands of Europe's valley floors which were already in use. In essence, Ricardo saw that the medieval trap had entailed more than just the inability to care for good farmlands, it had also included the tendency of
population pressures or maldistribution of arable lands to push cultivation beyond these good lands to more and more marginal lands.

The views of both Smith and Ricardo are relevant for developing countries today. Each identified an essential component of the problem of diminishing returns over time that had plagued Europe through the medieval ages. Smith noted that even good lands not properly managed will lose productivity with time. Such waves of diminishing returns on any given piece of land can only be averted if the individual cultivators who work the land adopt techniques that maintain or enhance soil fertility rather than degrade it on an annual basis. Ricardo pointed out that agricultural productivity secured on good lands cannot be sustained with equal amounts of capital and labor when cultivation extends to more marginal lands. Ricardo’s dimension of diminishing returns cannot be changed. Where all good arable land is presently in production, expansions of land in agriculture will yield decreased productivity per units of labor and capital applied.

Of course, Ricardo did not even deal with the fact that marginal lands are also much more susceptible to ecological deterioration than are good lands. In Scotland, the lowlands could recuperate fairly quickly once abandoned because of reduced soil fertility. In due course, agricultural production could be renewed until the next fertility decline. But marginal lands often suffer much worse deterioration because erosion, soil hardening or aridization may be induced by harsher ecological and geographical circumstances. Thus, as historical examples in Southern Europe, Northern Africa and throughout the Middle East indicate, marginal lands may never recuperate once they suffer the sort of diminishing returns that Smith identified in Scotland.
Maintaining Capital Stock

Infrastructure and labor-saving machines are fundamental to the achievement of increased productivity in any sector of the economy. The formation of physical capital, however, is not a one-time occurrence. All capital stock is subject to a certain natural rate of decay over time, a circumstance which is accounted for in the economic concept of depreciation. Allowances for capital stock depreciation are important, economists stress, because they distribute the cost burdens of replacing worn out capital over time. In fact, depreciation allowances can even provide a means of increasing capital, since replacement capital stock may be more productive than the capital that has worn out.

But depreciation accounts for the theoretical or expected life span of capital stock. It does not account for premature death or productivity declines resulting from improper use or poor management of infrastructure or equipment. This is an enormous and universal problem in developing nations, as Hirschman has noted:

(The lack of proper maintenance...is perhaps one of the most characteristic failings of underdeveloped countries and one that is widespread over the whole economic landscape. Eroding soils, stalled trucks, leaking roofs, prematurely run-down machines, unsafe bridges, clogged up irrigation ditches -- all testify to the same pervasive and paradoxical trait: the inadequate care for existing capital in capital-poor countries.

Of course, if premature decay of capital stock is so endemic as to be predictable, it is possible to alter depreciation allowances to compensate. This, however, is at best wasteful of scarce investment resources; it may ultimately impose such high costs as to make the process of replacing or existing capital unaffordable.
Thus, the attention paid to maintaining capital over time is all important to any economy, but especially one where existing capital stock is still small in proportion to population. Lengthening of the decay time-span for capital through better maintenance is tantamount to creating more capital because it frees up more financial resources for investment. Conversely, capital formation progress in a developing country may be significantly slowed or reversed if maintenance wanes or proves to be unduly expensive.

Throughout history, most societies relying on irrigated agriculture have experienced difficulties over time in maintaining irrigation networks even when the networks have been designed and constructed with indigenous labor and technology. Also, such long-term problems occurred in spite of the fact that most examples of hydraulic societies in history have been ones in which governments exhibited a high degree of control over the actions of individuals. The likelihood of maintenance problems arising in contemporary developing nations may be significantly increased since systems are frequently financed, designed and built with foreign assistance and technology and third world governments often have a great deal of difficulty coordinating or controlling the actions of disparate actors.

Natural resource management practices can be critical over the long term in determining whether many types of large infrastructural investments can be maintained adequately. For example, the major environmental related
threats to dams and irrigation systems are that they will become clogged with sediment or, in the case of irrigation networks, that inadequate drainage will result in long-term waterlogging or high salinization of the soil. In addition to the labor and fiscal resources that must be allocated, the task of maintaining dams and irrigation systems -- preventing excessive sedimentation, waterlogging and salinization -- is difficult for at least two central reasons.

First, how much maintenance is necessary and how quickly the consequences of ignoring maintenance will be felt are primarily exogenous factors unrelated to the construction and management of the infrastructure itself. Natural conditions in the upstream watershed, combined with the land use patterns and land management practices of numerous groups and individuals, determine how much sediment flows into and must be cleared from the system downstream. If extensive deforestation, or careless agricultural practices upstream are causing high rates of soil erosion, even highly efficient maintenance operations may be hard pressed to prevent long-term sedimentation problems that reduce the productive contribution of the downstream infrastructure. Yet, the groups or individuals who are contributing to the sedimentation problem not only have few incentives to alter their actions, they may not even suffer the costs of diminished irrigation or electricity production. Short of instituting harsh political or economic measures to bring about changes upstream -- a challenge which is extraordinarily difficult to meet -- a government may have few, if any, means of slowing the rate of sediment flow.
Second, maintenance of dams and irrigation systems to ensure that excessive buildup of sedimentation does not choke the system is a procedure that is primarily preventive in nature rather than responsible for increasing present production. This general phenomenon that frequently leads to the neglect of maintenance of virtually every kind of capital good is compounded by the fact that there is generally no specific threshold at which it is clear that a problem such as sedimentation is excessive.

This is true for irrigation systems -- where outlying ditches may fill up and be abandoned slowly -- or with dams -- where electricity generating capacity of a dam may be reduced in increments over a long period of sediment build-up. It is even more the case with regard to excessive salt build-up in many irrigated areas. Since the dissolved salts in irrigated waters do not evaporate, irrigated lands that do not have adequate natural drainage or where a man-made drainage system is not maintained will tend gradually to increase in their levels of salinity. Such build-ups may hardly be noticeable for years or even decades, but eventually the salt becomes so invasive that agricultural production becomes difficult and even impossible. Many irrigated lands through history have faced this problem of salinization. Often the long-term history of salt build-up can be charted in the gradual evolution of crops grown on the lands. Barley, for example, is a crop that is less affected by salt, so it often replaces wheat and other crops harmed by salt over time as salt build-up on irrigated lands proceeds.\textsuperscript{77}
Poor land management practices may affect the longevity of a number of other large capital projects: roads, agricultural terracing, housing projects all may become increasingly expensive to maintain as a result of deforestation, soil erosion, and flooding resulting from rapid water run off and the filling up of river channels. Harbors and navigable waters may also be plagued by excessive siltation from upstream land abuse. While the costs of maintenance for capital projects affected by careless land management may be paid incrementally they may be quite large and drain increasing amounts of development funds from other purposes with time. Worse yet, the costs or sheer logistics of maintenance may become so prohibitive in time that the entire project must be abandoned. This is not a hypothetical outcome; abandonment of large capital projects has occurred in a number of instances in recent years as a result of long-term environmental abuse that made maintenance too difficult to sustain.
Externalities

In the rush to achieve rapid economic growth by recreating the factories and cosmopolises of the industrialized countries, it is easy for developing country governments to lose sight of the side effects that accompanied industrialization and urbanization and subsequently demanded extraordinary remedial efforts in all Western nations. In fact, despite the obvious prevalence of many serious urban and industrial pollution-related problems in the third world, many observers have argued that pollution externality problems are only of secondary importance to countries still struggling to achieve rapid economic growth. One recent analysis noted:

It is often said that improvement of the environment is really the special problem of developed nations. The developing world, it is argued, lacking resources and facing the urgent need to industrialize and to provide minimal public services, cannot afford the luxury of additional investment to enhance the environment. Developing countries, the argument goes, would like nothing better than to find themselves in the situation of the developed nations. They want heavy industry, large urban centers, higher national and per capita incomes and so on. If these aims entail air and water pollution, traffic congestion, noise, mental stress and all the other problems and maladies that are endemic to the urbanized areas of the world, well, such are the costs of being rich and one has to be rich before one can start to channel part of the national income towards the solution of environmental problems.
Once economic growth has reached the level where people desire quality of life improvements and where "nonproductive" investments are more affordable, then some of the proceeds can be diverted into the physical environmental improvements that people demand. This certainly is the pattern followed by most Western nations during 19th and 20th centuries. First the environmental sacrifice was made; then the resulting industrial pollution, urban squalor, poor housing conditions, public health hazards and inefficient land use patterns were addressed after affluence was attained.

There is, of course, some logic to this sequence. Pollution and squalor are difficult problems to prevent in countries were people are very poor and industrial enterprises are in the fledgling stage. In the early phases of industrial development, as most development economists point out, countries (and private companies) depend heavily on maintaining high rates of savings for capital accumulation and on keeping the costs of labor, raw material and other aspects of production as low as possible. Pollution -- the disposing of wastes or by-products from industrial processes into air, water or adjacent land -- is another important means of minimizing costs for industries and governments. A backyard tannery or a low-technology pulp and paper mill would never even get off the ground if, from the outset, it had to make provisions for treating and neutralizing its effluent before sending it into a nearby stream. Furthermore waste treatment implies a degree of technical efficiency and control over the production process that may not be present for
many small, makeshift industrial projects that may be heavy polluters -- iron foundries, cement plants, tanneries, food processing operations for example.

The argument is often made by economists that from nature's point of view, too, it is not as necessary for a country at an early stage of industrial development to be seriously concerned about controlling pollution. All natural systems have a certain "assimilative capacity" to absorb, dilute and degrade most industrial pollutants and urban wastes. In underindustrialized countries the limits of this capacity generally have not been reached. A rushing river, a tidal estuary, a windy knoll, or even an uninhabited hillside may be able to dissipate pollutants naturally with few noticeable effects where the assimilative capacity of the natural environment has not been exceeded.

Thus, pollution control technology for factories or elaborate municipal waste treatment facilities would only duplicate at great waste of scarce capital resources what nature can accomplish. As a country reaches a stage of industrial development where nature's assimilative capacity is being taxed (implying that substantial economic growth is taking place) pollution control steps can be implemented incrementally. Although this is an argument for careful location of industrial facilities based upon ecological data and experience (a difficult enough task), it is quite frequently cited as a reason why developing countries not only cannot afford but also do not need advanced pollution control measures.
All of these points -- that developing countries can no more afford to pay pollution control costs than they can afford to pay high labor costs, that poor people are unlikely to be concerned about pollution, and that developing countries generally have large, unused "assimilative capacities" -- doubtless have some validity in theory when applied to an entire country. There are, however, a number of mitigating factors that make pollution problems in certain areas of developing countries more serious and people more aware of them than was the case for the now industrialized nations during their early stages of development.

First, of course, is the fact that with transfers of technology and knowledge and international demand for a wide range of industrial goods, developing countries today have undertaken a far wider range of industrial activities in a much shorter period of time than occurred for the first industrializers. The concentration of pollution problems from this telescoping of the time sequence for industrial development is significantly complicated by two other trends in industrial development in many developing countries.

Large, heavy industries of the sort that may generate noxious emissions or water effluent tend overwhelmingly to be located in a very small number of heavily industrialized, urbanized enclaves in most developing countries. Although total industrial pollution for a developing country may still be quite low by modern standards, the level of pollution in these areas of concentrated industry is often far higher than the worst levels recorded in the most industrialized areas of the West.
In addition, as many observers of international industrial location patterns have pointed out, firms in particular industries producing for world markets have a remarkable propensity to locate in close proximity to each other -- not only clustering in the same countries, but often at nearby factory sites. There are many reasons for this "piggyback" effect: availability of raw materials, marketing opportunities, enticements from governments, labor force specificaitons, etc. The result is that in a particular area total industrial pollution may again be relatively low, but it may be primarily a few high volume pollutants.

All these factors tend to mean that industrial pollution problems in developing countries are highly concentrated both in location and type. This problem is further exacerbated by the fact that industrial concentrations in developing countries tend also to be located in close proximity to the major urban concentrations. The combination of industrial pollutants, untreated sewage, garbage, vehicle emissions, and soot from wood, charcoal or coal fires means that air and water pollution are much worse than in many developed country cities by several orders of magnitude.

Moreover, many large third world cities are plagued by increasing congestion problems because of their size, the rapidity of their growth, and the inability to adapt street configurations and traffic flows to the exploding numbers of automobiles. Even in the best planned developing country urban areas, huge haphazardous squatter settlements (often on the most marginal, hilly, or polluted fringes of the city)only complicate the general problems of pollution, squalor, and congestion.
In the extreme, such environmental pollution problems may put a brake on economic development in major urban areas: choking off certain growth possibilities; draining capital for large public works or infrastructure just to keep the urban economy functional; forcing expensive and often unwieldy industrial decentralization plans for outlying areas where transportation, energy, infrastructure, building costs, and wage rates (for skilled and managerial personnel) are often higher; adversely affecting the health of the urban workforce; and leaving haphazard or poorly planned development subject to demolition in periodic natural disasters such as floods, mudslides, earthquakes, and monsoons.

Externalities caused by the urban and industrial sectors also spill over and impinge on other sectors of the economy frequently. Air and water pollution from all the sources described above have caused numerous problems for rural residents, notably farmers and fishermen, throughout the third world. Crops have been killed or their yields substantially lowered, and fishing in rivers and bays below major third world urban areas has almost invariably declined substantially in recent decades. The consequences of these developments are enormous for countries where a major percentage of the population still earns its livelihood from these pursuits and most of these people already subsist close to the margin.

Another type of externality that may adversely affect future economic welfare in the rural sector is that of the long-term public health consequences that sometimes result from rapid influx of modern
technologies. The two issues that have received the biggest concern in this regard are: a) indiscriminate and careless pesticide use by peasants and poorly equipped farmers; and b) the increases in the incidence of water-borne diseases that have often accompanied the construction of major dam and irrigation projects in the third world. In both cases, the benefits of the technology may be substantial, but the costs to individuals who suffer disease and sickness may be enormous. Better planning and more care can frequently significantly reduce the problems.
Conclusions

Twenty years ago, Robert Heilbroner chastized many of his fellow economists for perpetuating the notion that his generation would live to see substantial economic progress in many underdeveloped nations. For most of the third world, he wrote, "the next ten to twenty years of arduous effort are not apt to produce anything like a self-sustaining climb'. He concluded that while some nations would see substantial gains, "in a far greater number the mass of the population will conclude their initial stage of the march very little, if any, higher than their starting elevation." 80

In the 1980s, Heilbroner's words ring too true -- indeed, it is difficult to imagine that even by the year 2000 enduring economic progress will have become a reality for more than a score of the hundred plus countries that started the post World War II era as "backward areas." By almost any measure -- per capita income, geni. coefficients, physical quality of life indices, etc. -- it is likely that the year 2000 will pass with the mass of humanity still living in situations not substantially different from today.

Yet, the failure to register substantial economic progress in the majority of developing nations is not the biggest failure of economic development during the last three decades. Nor will it be the most significant failure of the coming two or three decades. Of far greater consequence is the fact that few of these countries are putting into place the framework which will nurture and sustain economic development in the future. Poor housing, ragged clothing, lack of amenities and modern services, hunger and poor diets are the signs of poverty in our times. But wastage of valuable resources without significant return on
investment, continued shortages of energy, population growth without off-setting economic advances, continuing poor productivity in the agricultural sector, underemployment in both the countryside and urban areas, continuing dependence on a small number of primary exports whose supply and world price both are subject to significant fluctuations, the deterioration of expensive capital equipment and infrastructures, and the careless generation of externalities that will later impinge on economic productivity; all these are problems which are signs forecasting continued poverty for future generations.

We have examined in this paper the many ways that environmental abuse and poor natural resource management may directly affect the present and future economic development prospects of countries and the welfare of the masses still heavily dependent on the land for food and as a way of life.

With well over 50 percent of the population living in rural areas and dependent upon the land for their well-being, and without adequate export revenues to pay for huge food and raw material imports, current economic welfare and future progress in many less developed countries will depend heavily on sustained and improved productive utilization of basic natural resources — soil, forests and water. For the foreseeable future, economic development, not to mention human welfare, in poor countries is going to continue to be heavily dependent upon the domestic availability of: wood for pulp and paper, home construction, fuel, foreign exchange revenues and a host of watershed functions; a soil base conducive to increased agricultural productivity to enable people to produce a surplus and feed an industrializing and urbanizing nation; and stable water resources for generating power, irrigation, food production, human consumption and industrial use.
Yet, in large numbers of developing countries today trees are being cut at rates far beyond any conceivable replacement level, fertile topsoils are being ravaged by erosion and bad agricultural practices, and water resources are being despoiled through abuse and neglect. Productive use of these resources is already marginal and continuing to decline in very poor countries such as Haiti, Nepal, Bangladesh, the Sahel countries and many regions within other countries in Africa, Latin America, the Middle East and Southeast Asia. If economic development prospects appear bleak today in these places, they will be even bleaker in the future as renewable natural resources continue to be degraded. The failure to secure the long-term productivity of their soil, forestry and water resources will undoubtedly make long-term economic growth difficult to sustain in many countries and virtually impossible to commence in some of the world’s poorest nations. As much as anything, then, sustainable economic growth and development in much of the developing world may await the time when developing countries establish some better means of managing basic renewable resources.
NOTES


3. Ibid.


Much of Africa is held back by its poor soil. The North of course, suffers from totally infertile sand, and the tropical regions from earths that compact to the hardness of concrete or that tear away in the violent rainstorms... It is not only Africa which suffers from this basic handicap. A great deal of the rain-forest soil of the South American Continent is also much less suitable for raising crops than its luxuriant forest cover would suggest. Across large areas of Asia, as well, the soil is also wanting: vast tracts of India are arid, while in China the land has long since been deforested and much of it overworked.

Much of the post-war cultural anthropology literature also dealt with the relationship between economic potential and environment. B.J. Meggers, for example, postulated that "the level to which a culture can develop is dependent upon the agricultural potential of the environment


Natural resources are, of course, essential as a basis for any economic development. Yet a comparison of the basic resources in soil, water, minerals, forests, and so on in the economically advanced parts of the world with those in the underdeveloped areas, where people live in poverty, suggests that the difference in economic level must depend to a considerable degree on other things than differences in these resources. It would be hard to maintain that the soil, water, minerals, etc. of England, Australia, Denmark, and Switzerland are so superior to the corresponding resources of the Philippine Islands, Indonesia, Burma, Iran, and Bolivia as to account for the tremendous differences in their economic levels. Many an underdeveloped country, though not every one, seems well enough endowed by nature to be described as "a rich land inhabited by poor people."

Heilbroner, *supra.*, note 12, pp. 35-36) decided that natural resource problems did not present insurmountable barriers to economic develop:

Without doubt the uneven allocation of the gifts of nature will make development much more onerous and expensive in some areas than in others...The pace and pattern of change must inevitable reflect the variety of nature habitats in which it must take place. But viewing the problem as a whole, there is no reason to consign the great bulk of the underdeveloped world to permanent poverty because of a tragic and uncorrectable degree of nature.

In his *Dissent on Development*, revised edition (Cambridge, Mass.: Howard University Press, 1967) p. 275, P.T. Bauer concurs:

Physical natural resources, notably fertile soil or rich minerals, are not the only or even major determinants of material progress, though differences in the bounty of nature may well account for differences in levels and ease of living in different parts of the underdeveloped world. It has always been known that physical resources are useless without capital and skills to develop them, or without access to markets. And the diminishing importance of land and other natural resources in production is also familiar. But the recent rapid development of some underdeveloped countries poorly endowed with natural resources has come as a surprise, though perhaps it should not have
done so, in view of the Japanese experience. A recent but already classic case is that of Hong Kong, which has practically no raw materials, very little fertile soil, no fuel, no hydroelectric power, and only a very restricted domestic market, but which in spite of these limitations has progress phenomenally.


18. Ibid. Kindleberger and Herrick, conclude:

A poor country with a high ratio of people to land can be under a severe handicap. Not only does it lack the technical capacity and capital that can be substituted for land, but it can confidently expect with development a further expansion of population and a further decline in the ratio of land to mouths...The existence of virtually unlimited supplies of rich land gives the lucky country (the United States, Canada, Australia, Argentina, Brazil et al.) much more freedom of action. Countries with masses of people crowded together on thin soil have fewer options open to them. They have a difficult time using labor efficiently because they lack the necessary complementary factor, land.


20. Ibid., p. 458.


22. Ibid., p. 466.


24. See Lewis, supra., note 7, p. 325.


28. W. Arthur Lewis, supra, note 7, p. 321, notes that the dilemma between depletion as a means of earning export funds for development capital or conservation for use by local industry in the future is particularly difficult for developing countries possessing coal or iron ore reserves.


32. Although political-strategic considerations have been important in U.S. trade relations with some LDCs, e.g., Taiwan and South Korea. President Reagan's proposed economic program for the Caribbean, including substantial trade concessions, is another example.


36. See Eckholm, supra., note 34.


39. Some of these factors are described generally in H. Jeffrey Leonard and David Morell, "The Emergence of Environmental Concern in Developing Countries: A Political Perspective," Stanford Journal of International Law, vol. 17, no.2, (Summer 1981). Two recent papers written under the auspices of the Research Program in Development Studies deal in more detail with these problems: James T. Thomson "Politics of Sahelian Desertification: Centralization, Non-Participation, Inaction;" and, H. Jeffrey Leonard, "The Political Economy of Environment and Development." These papers are part of a forthcoming volume on The Politics of Environment and Development. The research for the volume was funded by the U.S. AID.


45. Lewis, supra., note 41, p. 154.


47. Ibid., pp. 92-93.

48. For example, productivity in some parts of Africa has changed little since George Kimball wrote that: "The productivity is still so low that it takes anywhere from two to ten people -- men, women and children -- to raise enough food to supply their own needs and those of one additional -- non-food-growing -- adult. George Kimball, Tropical Africa (New York: Twentieth Century Fund, 1960), vol. 1, p. 572.


52. See especially, Eckholm, supra., note 5.


54. See World Development Report, supra., note 33, Table 9, pp. 150-51.

55. Ibid., p. 22; Brandt Commission Report, supra, note 2, p. 147

56. United Nations Department of International Economic and Social Affairs, supra., note 30, p. 10.


58. The movement of certain types of food production from the center of Europe to peripheral Atlantic areas helped relieve some of the ecological pressures on European lands and ensured that the fertility of good lands could be
retained and marginal lands could be used for other purposes than
bulk production of food staples. But these crops, produced for consumption
in Europe, "murdered the soil" in many places and created a situation
where production move steadily eastward because of continuous soil
exhaustion. See, Richard Pores, Merchants and Planters, Economic
History Review Supplement No. 4 (Cambridge, England: Cambridge University
I: Capitalist Agriculture and the Origins of the European World Economy
Wallerstein, The Modern World System II: Mercantilism and the Consoli-
dation of the European World Economy, 1600-1750 (New York: Academic Press,
1980) pp. 161-165. This issue is considered in more detail in H. Jeff-
rey Leonard, "Resource Limitations, Environmental Deterioration and Economic
Progress in History," paper written for the RPDS project, supra., note 39.

Destruction and the Development Dilemma in the West African Sahel
(Montclair, N.J.: Allenheld Osmun, 1980) argue that the overuse of
land for peanut production in the Sahelian countries had disastrous
effects on the soils of that region.


61. See the chapter on "Agricultural Development Projects," in
Raymond F. Basmann, John P. Milton, and Peter H. Freeman,
Ecological Principles for Economic Development (London: John
Wiley and Sons, 1973) pp. 140-181. Also Jack R. Harlan, "Crop
Monoculture and the Future of American Agriculture," in Batie
and Healy, supra., note. 40.

62. Although there is evidence that many LDCs, under the prodding
of international agencies and continued exposure to high inflation,
fluctuating terms of trade, and balance of payment difficulties,
are making more difficult and long avoided adjustments in fiscal
policies. United Nations Department of International Economic and
Social Affairs, supra., note 30, pp. 90-92.

63. Many of the problems that reduce the developing countries' abilities
to apply available fiscal resources most efficiently are discussed in
OECD, supra., note 1, pp. 197-285.

64. One of the most thorough examinations of the adverse ecological impacts
of development projects and new technologies introduced as a result is
found in M. Taghi Farvar and John P. Milton, eds., The Careless
Technology: Ecology and International Development (Garden City, New
York: The Natural History Press, 1972)

65. Wallerstein I, supra., note 58, pp. 25-26, 36-39, 216-217; Wallerstein II,
supra., note 58, pp. 14, 29, 132-133; Also, Charles R. Bowlers,
"Ecological Crisis in Fourteenth Century Europe," in Lester J. Bilsky,
(Port Washington, N.Y.: Kennikat Press, 1980); and M.M. Posten,
Essays on Medieval Agriculture and General Problems of the Medieval


68. See David Ricardo, supra., note 9, pp. 34-45.

69. Ibid., pp. 71-82.

70. Adam Smith, supra., note 21, pp. 250-480.

71. Ibid., pp. 111.

72. Ibid., p. 251.

73. Ibid., pp. 324-334.

74. Ibid., pp. 326-327.

75. Hirschman, supra., note 8, p. 141.

76. See Karl A. Wittfogel, "The Hydraulic Civilizations," in William L. Thomas Jr., ed., Man's Role in Changing the Face of the Earth (Chicago: The University of Chicago Press, 1956). In fact, Wittfogel argues that despotic governments emerge in pre-industrial societies which depend on irrigation agriculture because of the need to control water, administer the construction and maintenance of vast water works, and allocate the distribution of the water. This requires and in turn reinforces the highly centralized control of a small elitist bureaucracy.

77. See Eckholm, supra., note 5, pp. 115 ff.


100. "Environmental Pollution and Optimum Taxation Under Market Distortions in Developing Countries" by Gill C. Lim and Joon Koo Lee, October, 1981, pp. 18.


102. "Environmental Policies in Developing Countries: A Case of International Movements of Polluting Industries" by Joon Koo Lee and Gill Chin Lim, March 1982, pp. 19.
