ENVIRONMENTAL ISSUES FOR DEVELOPING ECONOMIES

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Summary

Nature provides vital support to an economy as the source of resources for its production and as the sink for its wastes. The entropy law of thermodynamics sets capacity limits on the source and sink, and thereby imposes biophysical limits to economic growth. Environmental crises arise when economic growth overshoots these limits (or carrying capacity), resulting in ecological degradation. This has an adverse feedback effect on the economic system. Fundamentally, it is certain institutional failures that have been responsible for such crises. The character of these failures, however, differs with the state of development of an economy. The overpopulated, poverty-stricken, bio-mass-based developing economies face environmental problems due to both the pressure of population and the unsustainable use of resources. The latter arise from failure of social and economic institutions to resolve the problems of property rights, externalities, and income distribution. This thematic paper begins by clarifying background conceptual issues and an analytical perspective on such problems. It then discusses various environmental issues related to population growth, sustainability of the resource base (including exhaustible resources), and waste disposal, in the context of developing economies. These analyses and discussions illuminate the mechanics and consequences of local institutional failures while keeping in view the global perspective on such resource related problems. The article also discusses some global environmental policy issues and north-south trade and trade policy related environmental issues, along with their developmental implications for the developing economies. Finally, it delineates the concept of sustainable resource use and explains the associated green accounting approach, emphasizing among other things the role of institutions such as collective action in the management of sustainable resource use.

1. Introduction

Economic development has involved continuous interaction between the efforts of human beings to improve their material well-being, and the processes of nature. While the environmental challenges of development have induced many scientific discoveries and innovations in technology and social organization, efforts at development have sometimes resulted in environmental degradation, economic and social stagnation, and human suffering. The major environmental issues relating to the development process are discussed here within the broad framework of the relation between the human system and the system of nature.

2. Economy—Environment Relationship

Conventional development economics presumes that the well-being of a society depends on the flow of consumption of goods and services by its people. With the help of science and technology and their own labor, human beings transform the resources of nature into goods and services products, which are used for either consumption or capital formation. After the consumption or capital use, the physical content of the product flows back into nature in a degraded state as wastes. In such economic processes of transformation of natural resources—biotic and abiotic—into economic products, and in their subsequent use, no basic constituent elements of matter and energy would be lost. However, any biotic or abiotic resource has a certain ordered structure. It is these orderly characteristics that enable the resource to render the useful service or to do the concerned work. With every use of the resource, its structure loses orderliness. The degree of disorder is called entropy. In the course of circular movement from the source in nature to the economy and from the economy to the sink of nature, the basic elements of energy and resources render utility to humans while moving along an increasing entropy gradient.

3. Environmental Capital Base and Environmental Crisis

The availability of low entropy matter and energy is limited in the earth. Stocks of exhaustible resources like minerals or fossil fuels cannot be augmented in the human time scale. However, ecological processes regenerate renewable resources in the earth. A small portion of solar light energy is transformed into chemical bond energy through photosynthesis in plants. This chemical energy provides food not only to the plants themselves but also to all kinds of animal organisms, including decomposers and microorganisms. Some of the low entropy biotic resources thus generated are used as renewable resource input for the human economic system, for food and non-food end-use purposes (e.g., biomass fuel, forestry based industrial raw materials, organic chemicals, etc.). The diversity of such biological resources is itself an important dimension of the natural resource base.

Apart from supplying inputs for the human economy's production system, nature provides a range of other services that form the underpinning for all human activity, and which are therefore of fundamental value. The bio-geo-chemical processes of the Earth as driven by solar energy ensure the operation of hydrological cycles that supply water resources, regenerate soil, recycle nutrients, control climate and floods, assimilate wastes, pollinate crops, and purify air to maintain the gaseous composition of the atmosphere. The biodiversity of the ecosystem has on the one hand significant influence on the gaseous composition and climate condition. It contains and preserves, on the other hand, a huge library of genetic information, which has immense option value because of the possible future human discoveries of their new end-uses. The totality of ecosystems that generate the biotic resource input for the human economic system and provide all the above non-market ecological services—which are crucial for human survival—forms the environmental resource base of the economy. This environmental resource base, along with the non-renewable deposits of minerals, ores, and fossil fuels constitutes the natural capital base (stock) of the economy.

With any renewable or regenerative resource there is potentially a danger of exhaustion due to overuse. If the economic system uses such resources at a rate higher than its rate of regeneration, there will be depletion in the stock of renewable resources over time. For example, harvesting of forest biomass for fuel or timber use at a rate higher than the rate of regeneration of the plant biomass leads to degradation of forests. Or, crop uptake of nutrients in agricultural activities can exceed the natural rate of regeneration of nutrients in the soil through the operation of the nutrient cycles of nature. It is in fact essentially the rate of flow of solar energy that ultimately sets a bound on the rate of regeneration of resources, along with that on the time rate of delivery of all ecoservices.

Another important eco-service provided by the environmental resource base is the degradation of the material wastes generated by the economic system. The regeneration of resources and the degradation of wastes are two services jointly delivered by the ecological processes of nature. If the waste products of the economic system are particularly biodegradable, these processes transform themselves in the course of interactive ecological processes between organisms and their abiotic environment through the bio-geochemical cycles driven by energy flow through the food chain. There are, however, limits on the time rates of such absorption of wastes by nature determined by the time rate of ecological processes. If the wastes of economic processes are not biodegradable, they will be degraded and rendered harmless only through natural weathering processes involving often quite slow geo-chemical transformation through interaction with the environment over a long period. The hazardous wastes that are man-made compounds can enter the biological system by getting concentrated in the tissues of living organisms without being degraded.

The rate of extraction of resources by an economy from the ecosystem and the return of wastes by the former to the latter are determined by the rate of growth of economic activities, along with the growth of the human population of the economy concerned. The maximum rate at which nature can absorb a given waste product or supply a given resource by regeneration through the ecological processes of a region is often far exceeded by the rate of this process as required by economic development, if the latter is to be sustainable. A resource crisis arises if the rate of regeneration of low entropy resources falls short of the required flow of resources from the ecosystem to the economic system, rendering the pre-existing growth level unsustainable. If the rate of the production of high entropy wastes, on the other hand, exceeds the rate of absorption of waste by nature per unit of time, the balance of waste is deposited in the ecosystem as pollutant. The stock of the latter would accumulate and such accumulating stock would affect adversely the productivity of the natural system, human health, and the regenerative function of nature. While the carrying capacity of an ecosystem is considered to be the maximum life-support it can provide at a level sustainable for its biological systems, its operative definition in the economic developmental context is considered in terms of the maximum size of human population—along with the economic activities of the latter—that it can sustainably support.

4. Population and Environment

4.1 Population, Environmental Resource Base and Poverty

The poor in the developing countries of the world are dependent on agriculture and the primary products of the environmental resource base. Population growth in poor economies with low labor productivity, inequality in income distribution, and high unemployment leads, therefore, to a rise in the number of people with no income and no property rights to well-defined resource endowments. Such people either join the landless labor class in the rural or urban system, or else try to survive by directly using the environmental resource base—for example, burning forests and converting them into cropland, or by forcible occupation of open access common property land. This leads to ecological imbalance in land use. The fuel needs of the poor also cause substantial over-harvesting of fuel wood from forests, causing deforestation. Deforestation and farming on hill areas cause soil erosion and flooding. However, even when rural marginal or poor farmers are able to stick to the land they possess, they often overuse it for cultivation, using unsustainable agricultural practices such as mono-cropping or shifting cultivation with too short fallow periods. Where there is no irrigation, this results in the exhaustion of soil nutrients. In most such situations, due to the pressure of population, people treat the common resources of the environmental resource base as open access, regardless of the legal status of such resources with respect to defined property rights. The overriding of property rights has often been the strategy of the poor for survival. The pressure of population on such economies, along with institutional failure, leads thus to a situation of straining the environmental resource base beyond its carrying capacity.

4.2 Human Population Growth

While the human population grew only very slowly for many millennia, population growth has accelerated rapidly during the past two centuries. The growth of human population—one of the major environmental stress factors to emerge in the twentieth century—is the result of natality and mortality at global level. At the regional level, the net immigration into the particular regions has been a further source of environmental stress.

Human fecundity is the driving force behind the birth rate. However, the realization of its full potential has been constrained by both the scarcity of life support and socio-cultural restrictions introduced because of high population density. Malthus predicted that, with normal death rate, the realization of human biotic potential would result in geometric population growth while in the long run the food production could increase only in arithmetic progression. As a result, the human population would exceed the carrying capacity of land in terms of the number that can be provided the subsistence food requirement. According to Malthus, environmental resistance factors in the form of acute scarcity of food and consequent associated ill effects such as famine, war, disease, pestilence, etc. as induced by population density, would raise the death rate to bring down the level of population again to carrying capacity.

Human beings have, however, made almost continuous adaptations to their technology, institutions, socioeconomic practices, customs, and culture to changes in environment due to population growth and have been able to increase carrying capacity, moderate population growth, and avoid the Malthusian disaster. The adaptation behavior of human society to changing population density has, however, depended upon the stage of development of man-made capital, technology, and other knowledge bases. According to the theory of demographic transition of human societies, at low levels of industrialization and income, both birth rate and death rates are high and population growth is slow. As an economy industrializes and grows in terms of income, employment, and quality of life, both the death and birth rates fall, the latter with a lag of one to two generations. This causes a gap between the fertility and the mortality rates and consequently rapid population growth. As an economy reaches the advanced stage of industrial development and its peoples' life style evolves into full industrial mode, the birth rate falls further, almost to the death rate level, and the population growth rate falls and may even become zero or negative. Rises in the level of education, women's status in society, and the development of culture as associated with economic growth cause a shift in preference in favor of smaller families (i.e. fewer children per family), and use of family planning methods. The reduction in the infant mortality rate with development has a definite role in influencing the choice in favor of a lower fertility rate. Table 1 shows the inter-relationship between per capita GNP and the natural growth of population, as well as with the total fertility rate, exhibiting the broad correspondence between the demographic parameters and the stages of development.

	Per capita GNP (US $ 1998)	Population Density per Sq.km.(1998)	Total Fertility* Rate (1997) Birth per woman	Population Growth Rate Annual average growth rate % (1990–98)
1. Low Income Country				
(a) China	750	133	1.9	1.2
(b) India	430	330	3.3	2.0
(c) Countries Ex. China and India	380	45	4.4	2.6
(d) Over all	520	85	3.2	2.0
2. Middle Income	2950	26	2.5	1.5
3. Low and Middle Income				
(a) East Asia and Pacific	990	114	2.1	1.5
(b) Europe and Central Asia	2190	20	1.7	0.2
(c) Latin America and Caribbean	3940	25	2.7	1.9
(d) Middle East and North Africa	2050	26	3.7	2.6
(e) South Asia	430	273	3.5	2.1
(f) Sub-Saharan Africa	480	27	5.5	3.0
(g) Over all	1250	50	2.9	1.8
4. High Income countries	25510	29	1.7	0.7
5. World	4890	45	2.8	1.6

Source: World Bank (2000): World Development Report 1999-2000, New York, Oxford University Press.

Table 1. Population Density, Fertility, Growth, and Level of Development

4.3 Overcoming the Constraints of Carrying Capacity: Technology, Trade, and Migration

While the demographic parameter of population density is an immediate determinant of environmental stress in a given region, its actual impact on the state of the economy and the environment would depend on the availability of man-made capital and technology relative to the natural capital base. The developing countries are endowed with relatively low stocks of man-made capital, but with quite rich or poor environmental resource base depending on soil quality and bio-climatic conditions. As the efficiency of use of natural capital depends on the availability of man-made capital and technology, the higher availability of the latter plays an important role in enhancing the carrying capacity of the environmental resource base. Examples of the latter are biotechnology or modern agricultural practices augmenting the availability of food from the same arable land, or multistoried housing and flyovers in large cities augmenting the carrying capacity of urban land for housing and transport.

Apart from technological development, human society in any given region has tried to overcome the constraints of environmental resistance to growth in population density by opening up the social and economic system to the following changes: (a) the migration of population and (b) the trade of commodities and services across regions. In the history of human civilization, most of the great intercontinental or intracontinental migrations took place because of the pressure of population on local land and resources, and because of the emergence of better employment and economic opportunities elsewhere provided by natural resources, man-made capital, and technology. While low natural resource endowment per capita has tended to push people out of a place or a region, high natural resource endowment tended to pull or attract population. In the act of migration, human beings carry capital and technology across national boundaries, but not the natural environment and its resource-generation ability. Man-made capital has therefore found higher marginal returns where resource-to-man ratio is high and man-made capital base is small. The great migrations of the nineteenth and the twentieth centuries from Europe and Asia into North America, Africa, Latin America, and Oceania can be explained in terms of such variations in resource-to-man ratio, among other factors.

However, the development of nationalism in tandem with industrialization and economic development has gradually induced many countries to put up resistance to such immigration of people from other countries, particularly from the poor, overpopulated ones, except in situations of labor shortages. Nationalist desire to protect one's own economic interests, identity, and culture has led to legal and political initiatives on the part of the relatively developed countries to deal with the pressure of immigration. The present global consensus is, however, in favor of encouraging movement of capital, technology, and trade in goods and services, rather than the migration of people to correct the adverse effects of regional imbalances in ecological resources-to-human population ratio.

Remaining with the issue of migration, one may, however, argue that migration from rural to urban areas has happened significantly in developing countries through the urbanization process and industrialization, in spite of the low land-to-man ratio and the scarcity of other natural resources in an urban ecosystem. An explanation can of course be quite easily given in terms of relatively high levels of development and the availability of infrastructural capital as well as the heavy importation of resources into the urban centers from the rural parts of the economy. Highly energy-intensive industrial development and technological achievements in the urban centers and the contiguous suburban areas raise vastly the number of people that can live in such areas. However, one should also note that many hundreds of acres of land, thousands of liters of water, and huge amounts of other natural resources are required to provide support to these "hot spots" by supplying food and other life-supporting services and raw materials for industrial development. The heavy importation of resources from rural ecosystems has turned such urban centers into places of better economic opportunities in terms of more employment, higher wage rates, better standards of living and quality of life by improving the supply-side conditions. Such urban centers thus attract population while rural poverty pushes people out of the rural economies, particularly in places where agricultural productivity is low, land is too fragmented, and non-farm income opportunities are low.

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